Vol. 15 JUNE-SEPTEMBER, 1944 Nos. 2 and 3

CHILD DEVELOPMENT

PUBLISHED QUARTERLY BY THE SOCIETY FOR RESEARCH IN CHILD DEVELOPMENT
NATIONAL RESEARCH COUNCIL
2101 CONSTITUTION AVENUE
WASHINGTON, D. C.
Made in United States of America

CHILD DEVELOPMENT

Vol. 15

JUNE-SEPTEMBER, 1944

Nos. 2 and 3

PUBLISHED QUARTERLY BY THE SOCIETY FOR RESEARCH IN CHILD DEVELOPMENT
NATIONAL RESEARCH COUNCIL
2101 CONSTITUTION AVENUE
WASHINGTON, D. C.
Made in United States of America

SICKNESS ABSENTEEISM AMONG WHITE SCHOOL CHILDREN IN HAGERSTOWN, MARYLAND, 1940-43

ANTONIO CIOCCO AND ISIDORE ALTMAN
Division of Public Health Methods
U.S. Public Health Service

To gauge accurately and with timeliness the changes occurring in health conditions is always important, but never more than at present when the civilian population must be maintained at a high level of efficiency in the face of a curtailment of civilian medical resources. Sickness and death rates among children constitute sensitive indices of a population's health level. The sickness rates in particular are useful since they reflect conditions which can be deleterious to the well-being of the population even though they are not fatal. Because of the value of such information, monthly data have been collected on school absences due to sickness among the white children of Hagerstown, Maryland, since October 1940. A three-year record, covering the school years 1940-41, 1941-42, and 1942-43, is presented here. For the year 1941-42 it was necessary to terminate the project by March 1st because of decrease in personnel.

Absenteeism among the school children of Hagerstown has been studied off and on for some twenty years by the U. S. Public Health Service. This city was selected in 1921 for one of the first morbidity surveys in the country because it was considered a typical community, neither completely industrial nor completely agricultural, and having in addition a high proportion of stable American-born stock. Studies pertaining to other aspects of public health have been continued there since, for this same reason and especially because the civic and school authorities, the health department, and the population itself have all demonstrated a high and unusual degree of cooperation. A preliminary comparison with earlier data has already appeared (1).

The particular value of the observations made in this community is that information is at hand to weigh the significance of changes in terms of a mass of data extending back over many years. Thus, changes which occur may be properly evaluated in terms of the experience of the past and of all the information available about the children and their families.

The war has affected Hagerstown because of its important industry but it has not become a war-boom area. The population between 1940 and 1943 has increased from 32,500 to 40,000. Its prewar physician population of 44 has decreased by 10, bringing the number of persons per physician from 740 to 1,175.

CHILD DEVELOPMENT, Vol. 15, Nos. 2-3 (June-September, 1944)

Material and Method

A record of absences by cause has been collected on all the white school children of Hagerstown for various periods since 1921 (1, 2). The technique employed is briefly this: Children who are absent for any length of time present to their teacher an excuse slip containing among other items the reason for their absence. Where the reason is sickness, certain pertinent questions are to be answered - the cause of the sickness, its duration, and whether or not a physician was called. Whenever it appears warranted, a check is made with the physician to learn the precise diagnosis. These slips are collected and tabulated monthly.

In this paper the amount of sickness is measured by the number of days absent because of sickness per 100 children-school days. For any specific cause the formula is:

$$\frac{\text{Days absent in month for specific cause x 100}}{\text{Children enrolled x number of school days in month}}$$

The rates for all ages combined have been adjusted to the age distribution of the children attending Hagerstown schools in 1940-41. This adjustment is made by 1) calculating the age specific rate for the years following 1940-41, 2) multiplying each age specific rate by the proportion of children in that age group in 1940-41, and 3) summing these products to get the adjusted rate for all ages combined.

In Table 1 are shown the average monthly school enrollment and the average monthly number of children-school days, or days of exposure. It will be observed that the data are based on some 6,500 children and a school month of about 20 days.

Sicknesses which result in absence from school do not lend themselves to precise diagnostic classification and, for the more frequent causes of absence, physicians or nurses are not consulted by the parents. The causes of illness, therefore, can only be described in broad groups, and it has been found best to deal with only five principal categories. The first group is "colds." The second group is made up of the more definite types of respiratory conditions; these are classified as "other respiratory" and include grippe, influenza, pneumonia, bronchitis, etc. The third, "digestive," is for the main part composed of the indefinite gastro-intestinal disturbances to which children as well as adults are prone. The fourth category is "headaches," which is a rather important if somewhat vague cause of absence due to sickness. In the fifth category, "other sickness," are included the major communicable diseases which affect children:

TABLE 1

ATTENDANCE IN HAGERSTOWN, MARYLAND SCHOOLS IN A THREE-YEAR PERIOD* (WHITE CHILDREN ONLY)

Age (years last birthday)	Average number of children			Average monthly number of children-school days		
	1940-41	1941-42	1942-43	1940-41	1941-42	1942-43
All ages	6,505	6,669	6,507	134,675	127,391	130,930
Under 7	1,459	1,413	1,528	30,270	26,982	30,748
8 and 9	1,092	1,102	1,086	22,412	21,055	21,858
10 and 11	1,114	1,133	1,218	23,116	21,638	24,517
12 and 13	1,233	1,305	1,241	25,579	24,938	24,976
14 and over	1,607	1,716	1,434	33,298	32,778	28,831

*Based on the months October through May for 1940-41 and 1942-43, and October through February for 1941-42.

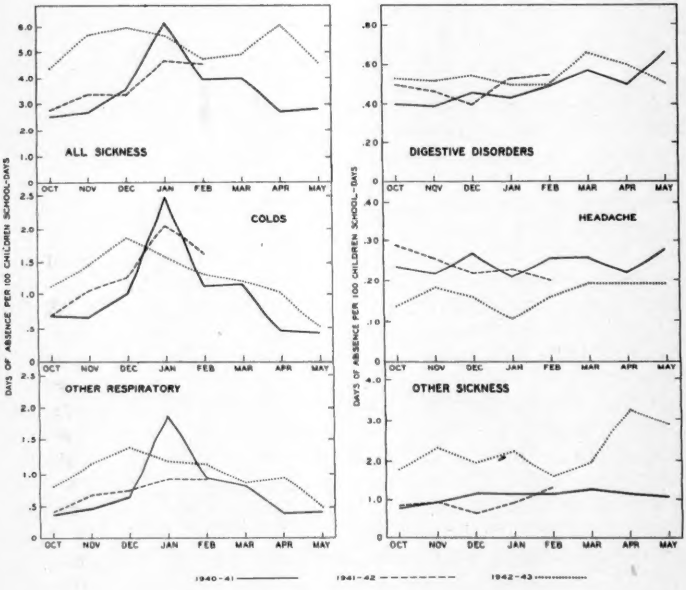

Figure 1. Days of absence due to sickness per 100 children-school days, from all causes and certain broad groups of causes - Hagerstown white school children, 1940-43.

chickenpox, mumps, measles, as well as a miscellany of conditions not covered elsewhere.

The findings are summarized in Figure 1 which consists of a set of sub-figures, one for all sickness combined, and one for each of the groups of illnesses specified above. The data for the three school-years covered are superimposed one upon the other to facilitate comparisons and to bring out the factors common to all the school years studied.

Rates 1940-1943

All Sickness. It is well known that in this climate more sicknesses occur during the winter months than at any other season of the year. Confirmation is lent by the data on all sickness. In 1940-41 the rate started from a low of 2.6 days of absence per 100 children-school days in October, rose to a peak of 6.1 in January, and fell again with some regularity to a rate of 2.8 for May. The same general pattern is seen for the available period of 1941-42, although the January peak was much lower than that for the year previous. In 1942-43 the pattern differed markedly, the absence rate being higher in general. Two peaks are to be noted, one in December and the other in April, with respectively 5.9 and 6.0 days of absence per 100 children-school days. The low points occurred in October, February and May. The significance of these variations will appear in the discussion of the specific groups of causes.

Colds. Colds are by far the greatest single cause of school absence due to illness. Their effect on the all sickness rate is readily observed in the similarity between the figures for colds and for all sickness (except for the Spring of 1943). In general, colds are the reason for between a fourth and a third of all days of absence due to illness. In the peak months (January, 1941 and 1942), colds accounted for over 40 per cent of all days of illness-absence. The peak in January 1941 was also associated with an outbreak of mild influenza which took place at that time. Comparison of the three years shows that the year 1942-43 differs from the two previous years in that the peak was not in January but came a month earlier.

Other Respiratory. In general, other respiratory diseases (grippe, influenza, tonsillitis, sore throat, etc.), when their absence rates are combined, follow the sickness pattern shown by colds. However, only the 1940-41 observations display a definite peak, due largely to the outbreak of influenza which occurred during the winter of that year. The 1942-43 data show a light rise in December but this is apparently of no great significance.

Digestive Disorders. Digestive diseases are another serious cause of absence from school. The incidence of these disorders is higher in the terminal months of the school year although no marked seasonal variation is noted. No uniform differences among the three years are to be found except for some tendency in the 1942-43 rates to be higher than those in 1940-41. However, the differences are not statistically significant.

Headaches. Headaches show only slight seasonal variation. In both the 1940-41 and 1942-43 school years, a low point was reached in January. This and the fact that the rates in 1942-43 were consistently lower than those in the other two years, suggest the existence of some kind of inverse relationship between headaches and colds, in the sense that when colds are prevalent, they furnish a more urgent excuse for absence for those children prone to headaches.

Other Sickness. The absence rates for all other causes of sickness show no regular seasonal variation as such; peaks in the curve can usually be traced to outbreaks of some communicable disease. The year 1942-43 experienced absence rates twice as high as those in the preceding two years. The extremely high peak in April 1943 was the result of an outbreak of measles; the smaller peaks in November 1942 and January 1943 were largely brought about by outbreaks of mumps and chickenpox.

Other Absences. It is important to examine the absences due to causes other than sickness since they reveal trends concerned with social and economic factors which bear on absenteeism in general. The year 1942-43 was marked by a large increase in absences supposedly not due to illness, the rates ranging from 1.8 to 2.9 days of absence per 100 children-school days as compared with a range of 1.4 to 2.1 in 1940-41 (figure not shown). Two peaks were noted in 1942-43, one in December and one in April. These peaks may be associated with attempts on the part of the parents to prevent infection of the children during outbreaks of the contagious diseases mentioned, but this cannot be stated with any degree of certainty.

Conclusion

In general, it is difficult to discern any definite trend with regard to increase or decrease of absences due to illness during the three years examined when the individual groups of illnesses are studied. The year 1942-43 was marked by outbreaks of three communicable diseases frequent among children. These may have affected absenteeism caused by the other conditions discussed. In 1941-42 and the following school year there occurred outbreaks of upper respiratory infection. This was not

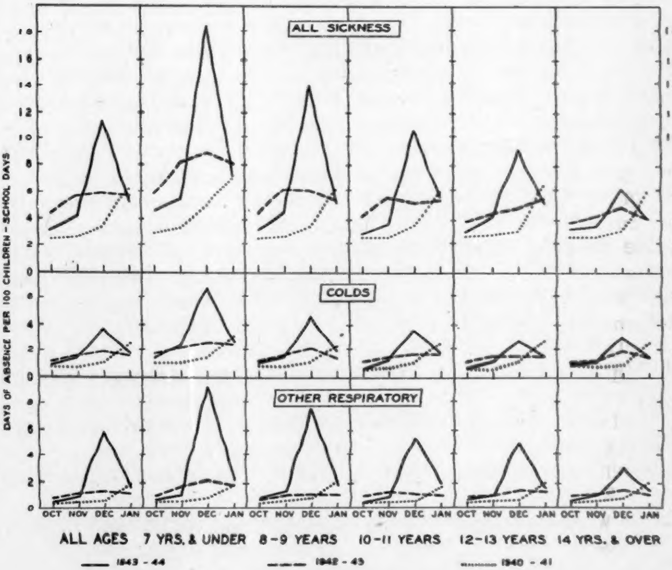

Figure 2. Days of absence due to sickness per 100 children-school days, from all causes and from colds and other respiratory conditions - Hagerstown white school children, October 1943-January 1944.

repeated in 1942-43. Previous studies of absenteeism among Hagerstown school children point to a long-time increase in absenteeism due to minor conditions such as colds and minor digestive disorders (1). This increase may perhaps also be attributed to increase in parental solicitude.

Influenza Outbreak of November-December 1943

Data at hand for the current school year, 1943-44, have not as yet been analyzed. However, because of the interest in last winter's influenza outbreak, data concerning it are presented in this paper. Figure 2 shows the days of absence per 100 children-school days for all sicknesses, for colds, and for other respiratory ailments. Because of the mild form of the disease probably no sharp distinction was made between colds and influenza. Two principal observations are to be made regarding the contents of the chart. The first is the explosive character of the outbreak and its very rapid subsidence, so that by January the rate of absence due to illness returned to "normal." The rate of absence due to sickness in December 1943 was over twice that in December 1942 and over three times that in December 1940.

The second important observation to be made lies in the differences among the age groups. As age increased, the rate of absence for respiratory ailments dropped. It does not neccessarily follow that the disease case rate was lower. The age difference in absenteeism could reflect; instead, the greater readiness on the part of the parents of younger children to keep them at home when illness threatens.

REFERENCES

(1) Ciocco, A., Cameron, W. R., and Bell, E. A comparison of the morbidity of Hagerstown, Maryland, school children in 1921-1925, 1935-1936, and 1939-1940. Milbank. Mem. Fund Quart., 1941, 19, 375-401.

(2) Collins, S. D. Morbidity among school children in Hagerstown, Maryland. Pub. Health Rep., 1924, 39, 2391-2420.

AUTISTIC THINKING AS A
"TRANSITORY PHENOMENON OF CHILDHOOD"

GELOLO McHUGH
Barnard College

The research for this report resulted from reading a description of T. V. Moore's report on the reasoning ability of young children (3) in Norman L. Munn's chapter on Basic Symbolic Processes of Children (4, chap. 11, p. 367 f). Munn cites Moore's study as presenting the only evidence available, to the date of publication of his book, on autistic thinking in childhood, and presents a thorough coverage of Moore's findings and conclusions. Moore's research (3) was not confined to the investigation of autistic thinking in childhood. In an effort to devise a reasoning test for the insane he presented a triple group of reasoning tests to 205 school children as a preliminary survey with the intention to standardize his test in terms of the intelligence of the child. His test, which he presents in full, was made up of three types of problems: 1) reasoning, 2) autistic fallacies, and 3) logical fallacies. For problems 1 and 3, Moore's findings are in general agreement with those of other research workers on these aspects of mental development in childhood.

A critical evaluation and summary of research on development of reasoning ability in childhood has been presented by Huang (2), who concluded from the assembled evidence that natural phenomena are seldom explained in animistic or magical terms by children and that, while their everyday conceptions of reality and causality "may be simple, naive, and incorrect, they are of the same warp and woof as the 'physical' conceptions of the everyday man in the street." He further states that normal experiences impose fairly valid conceptions of causality upon the growing mind of the child while the type of causality indicated by the child in answering questions is determined by age, intelligence, cultural milieu and, above all, the form and content of the question. The last point made here will be of importance when Moore's results on autistic thinking in childhood are considered. Huang, whose report covers the available literature on the development of reasoning ability in children up to its publication in 1943, further states that "child animism simply means ideas obtained from the biological and social spheres misapplied."

Munn (4, chap. 11), also surveyed the literature up to his date of publication (1938) and except for the statement, "Moore believes that autistic thinking is a transitory phenomenon of

CHILD DEVELOPMENT, Vol. 15, Nos. 2-3 (June September, 1944)

childhood,"[1] concludes that "there is clear evidence that ability to reason improves gradually as a function of age. There is no clear evidence that the reasoning processes of children are qualitatively different from those of adults. Differences between child and adult reasoning may be attributed to differences in the amount of information possessed."

Huang and Munn adequately cover experimentation and results on childhood development in reasoning ability for the purposes of this paper. The principal concern here is with autistic thinking in childhood, a special aspect of the development of reasoning ability in children, which appears to have been studied directly only by, and defined especially only by, Moore in his 1929 publication (3).

Moore's Definition and His Test

Moore defined autistic thinking, which pathologically is most developed in schizophrenia or paranoid states (6), as a "tendency to draw conclusions based on a pathological major in the sense of a false premise that has no basis in logical common sense." A somewhat similar definition of autistic thinking may be added here from Hollingworth (1, p. 234) who states, "autistic thinking is not thinking freed from reality, it is thinking that strays far beyond perception and does not dip back into it again. That is, its meanings are not finally realized in preceptual completeness, or in Dewey's terms, are not verified."

Moore's discovery of autistic thinking as a phenomenon of childhood is incidental to his standardization of a test which aimed to measure the child's ability to detect and reject such thinking. This test comprised the following four statements which were presented to each of 205 school children, 6 to 12 years of age, with a request that they state whether each statement was correct or incorrect followed by a request to tell why the answer just given was believed to be right:

1) If I had a thousand dollars, I could satisfy my heart's

[1] *"Moore's results on verbal reasoning show that adults make better scores than children, but there is no evidence of an essentially different reasoning process in the two groups. In detection of logical fallacies similar results were obtained. There was a rather wide divergence between scores of children and adults in the detection of autistic fallacies. Moore believes that autistic thinking is a transitory phenomenon of childhood since he failed to find it in many adults. However, the difference between children and adults may be largely linguistic in origin." (4, p. 369)*

desire. But I must satisy my desires. Therefore, I have a thousand dollars.

2) If one washes he cleanses himself from dirt. If one sins, he is dirty. If one washes, he cleanses himself from sin.

3) One who does wrong helps toward the destruction of the country. I have done wrong. Therefore, I am responsible for the destruction that is coming on the world.

4) If one is like another in a great many points, he is the same thing as the other. But a man I know has the same duties to take care of the country as the President, he thinks like him, and looks like him. Therefore, this man whom I know is the President.

In scoring this test no account was made of whether the child's answer was correct or incorrect. He was credited with an answer only when he gave a satisfactory response. A satisfactory response to fallacy 1 was any answer which implied that the child understood that desires need not be satisfied in reality no matter how strong they may be to the one who experiences them. For fallacy 2, any answer was considered satifactory which pointed out the distinction between bodily uncleanliness and moral guilt. For fallacy 3, any answer was considered satisfactory which pointed out the disproportion between one individual's wrongdoing and the destruction of the whole world. And, for fallacy 4, any answer was considered satisfactory which implied that the child knew that no matter how much two people resembled each other, they could not constitute one individual.

In applying the above test to his subjects Moore obtained results which indicated that the ability to detect and reject autistic fallacies is just beginning to develop by the 12th year of age. It was found that no 6-year-old children and no 7-year-olds could detect and reject any of the fallacies. The 8-year-old group detected only 1.25 per cent of these fallacies; the 9-year-olds 4.00 per cent; the 11-year-olds 14.2 per cent; and the 12-year-olds only 23.1 per cent. This test was also administered to 113 first year women college students who were able to detect and reject 83 per cent of the total fallacies presented. In addition to the above results, Moore found that while 8- and 9-year-old children begin in a small way to detect and reject autistic fallacies, children of about 10 years of age show a tendency to reason autistically. His evidence for this finding is in

the form of a table (3, Table 4, p. 25) in which it is shown that nine subjects with C.A.s ranging from 9-8 to 11-9 and M.A.s ranging from 9-8 to 12-5 accepted autistic fallacies. This group, slightly superior as to M.A., are shown, through the reporting of their responses to the fallacies, to have supported a relation between bodily uncleanliness and moral guilt, fallacy 2, in eight cases, and a relation between individual wrongdoing and world destruction, fallacy 3, in one case. With this evidence, plus the fact that no one in his group of 113 women college students accepted and supported a fallacy, Moore concludes that autistic thinking is a transitory phenomenon of childhood. Moore states that the inability to detect and reject autistic fallacies "may partially result from the fact that no test to partial out language was used," but he offers no suggestion as to why children of 10 years of age are likely to pass through a period of autistic thinking, as a state of mental growth.

It is believed by the writer that an inspection of the language used in Moore's other two tests of reasoning, logical reasoning and logical fallacies, reveals words or arrangements of words no less complicated or difficult to understand than those found in the test for the ability to detect autistic fallacies. If this is true, it may be that some factor or factors other than "the ability to understand what was said" operated to prevent the subjects from scoring as well on autistic fallacies as they did on logical reasoning and logical fallacies. It is proposed here that part of the reason for failure of Moore's younger subjects to register at all on the autistic fallacies test may have been the fact that the detection of errors in reasoning is foreign to the experience of 6- and 7-year-old children. Furthermore, the autistic fallacies test was preceded by a test of logical reasoning which may have given the subjects a mental set which prevented perception of what was expected of them with the autistic fallacies. That Moore's younger subjects did not do as well on the detection of logical fallacies as they did on logical reasoning is evidenced by the fact (see Table 2) that the 6- and 7-year-olds scored acceptably on 23.1 per cent and 24.8 per cent of the reasoning test items, while they scored only 5.8 per cent and 9.6 per cent, respectively, on the logical fallacies. These scores tend to support the hypothesis that detection of errors in reasoning is more difficult for the young child.

With regard to Moore's discovery of autistic reasoning as a transitory phenomenon of childhood, the writer would argue that this conclusion is based on results obtained through the use of two fallacies which contain pathological majors, in the sense of false premises with no bases in common sense, that are often actually taught to children by adults in a misguided effort

to protect them from moral wrongdoing. An attempt to establish a connection in the mind of the child between sin and dirt is a common practice. A survey of the responses of the writer's subjects who accepted Moore's second fallacy disclosed that they felt it correct for children's mouths to be washed out with soap after the utterance of unacceptable words. The writer has made a casual survey of opinions of middle class mothers with regard to the practice of washing a child's mouth after he says a "dirty" word and found a significant percentage who advocated this as a method of cure. A large number of modern tests in psychology decry current social and moral educational practices with children which set about to establish a connection between sex interests and practices as sin, and dirt or filth. The ceremonies of almost all religious groups in which water symbolically purifies from sin or protects from evil are further common experiences with a connection between washing and relief from sin in the life of the usual child.

With regard to Moore's third fallacy involving a connection between individual wrongdoing and coming world destruction, which furnishes the remainder of the evidence for autistic reasoning in childhood, one has only to listen to some of the religious sermons broadcast by radio to determine that it is entirely possible for the naive child, with no counter teaching in the home, to learn connections of this kind rather than to develop a tendency to originate them as a result of mental growth. In addition to this suggested evidence for the possibility of such connections being learned, the writer submits partial results from an unpublished questionnaire study, done in 1943, which indicate that significant percentages of theological students, Sunday School teachers, and parents would have young children taught that "the present war results from man's failure to please a personal God who has sent the war for punishment." These criticisms of Moore's use of fallacies 2 and 3 and of his interpretation of results obtained appear to be supported in the statement of Huang referred to on page 89 of this paper.

Subjects and Procedure in the Present Experiment

The subjects of the present experiment were 70 public and private school children.[2] These were selected so as to have 10 at each age level for years 6 to 12 and to have 5 in each group

[2]*Sixty of the subjects were pupils at the Hunter Model School, Hunter College, New York City, and 10 were pupils of the Horace Mann School, New York City.*

who were of average or slightly superior I.Q. and five of exceptionally superior I.Q. The subjects of exceptionally superior intelligence were used because the writer entertained an hypothesis that the detection and rejection of autistic fallacies might depend more upon M.A. than upon C. A.

Since the hypothesis was entertained that failure of Moore's subjects might have resulted from inexperience in detecting errors in reasoning plus a mental set to solve problems from the preceding logical reasoning test, it was decided to administer the following items from the 1937 revision of the Stanford Binet Test, form L (5), before administration of Moore's autistic fallacies: 1, Picture Absurdities I, e.g. a) man with umbrella, etc. with all four of the Binet test items of this kind used; 2, Verbal Absurdities, e.g. a) "They found a man locked in his room with his hands tied behind him and his feet bound together. They think he locked himself in," etc. with all four such items used; 3, Finding Reasons, e.g. a) "Give two reasons why children should not be too noisy in school," etc. with all four such items used. Numbers one and two were included because they are items which require the subject to detect errors and because it was hoped that they might promote a mental set in a direction conducive to the detection of autistic fallacies. Item three was included because the subjects are required to support their answers of "correct" or "incorrect" to the presentation of each of Moore's fallacies.

All of the above items were administered in accordance with the manual of instructions for the Stanford Binet Test (5). At no time was the subject informed as to correctness or incorrectness of his responses and no information of any kind was given as to a possible connection or relationship between the type of reasoning required by some of the test items and that required when the fallacies were administered. The Binet items were administered individually in the order given above and were immediately followed by the individual oral presentation of Moore's four autistic fallacies. After the examiner had read a fallacy the subject was asked to state whether it was correct or incorrect and, following this, to tell why he believed his answer was right. As in Moore's study, the subjects' statements as to the correctness and incorrectness of the fallacies were disregarded. They were credited with answers only when satisfactory responses were given. The criteria for satisfactory responses are given in detail on pages 90 and 91. Since the Binet items served only as a test to precede the autistic fallacies test, no report will be made here on scores earned by the subjects. For the reader's information, however, no subject failed all of the Binet items and almost all of the subjects

passed a major percentage of the items.

Results of the Present Study

The results of this study are shown in Tables 1 and 2. Table 1 shows a gradual increase in ability to detect and reject autistic fallacies with increase in chronological age from the sixth to the twelfth year. Since subjects of exceptionally superior I.Q. made better scores on the test at all age levels than do subjects of only slightly superior I.Q., a claim may be made for a relationship between mental age and ability to detect autistic fallacies that may be greater than the relationship between the ability and chronological age.

A comparison of Tables 1 and 2 shows that the subjects of the present report differ radically from Moore's subjects in growth of the ability to detect and reject autistic fallacies. The data of the present study, Table 1, offer evidence that the growth of this ability does not differ significantly from the growth of ability to solve logical reasoning problems and to detect logical fallacies. The fact that the subjects of the present report made better scores on the autistic fallacies test than Moore's subjects made on his logical fallacies test may be due to selection, since even the "slightly superior I.Q. group" of this study appears to be more selected as to intellectual status than the average of Moore's subjects, whose I.Q. range was between 90 and 110. The fact that the subjects of this study who were of exceptionally high I.Q. made better scores on the autistic fallacies test than did Moore's adult subjects, Table 2, appears to further support the claim for a closer relationship between M.A. and ability to detect and reject autistic fallacies than between C.A. and this ability.

With regard to Moore's finding of a tendency for children to reason autistically as a "transitory phenomenon of childhood," the following results were obtained. At the 6-year level four of the "exceptionally superior I.Q. group" accepted and supported five fallacies, or 25 per cent of all fallacies presented to the group. In three of these instances, the fallacy accepted was Number 2 which involves a connection between sin and dirt. In the remaining two instances, the fallacy accepted was that which involves a connection between individual wrongdoing and coming destruction of the world. It is interesting to note, Table 1, that the mean I.Q. of this 6-year-old group is 167, which means that their mean M.A. approximates that of Moore's 10-year-old group which furnished evidence for his conclusion that autistic reasoning is a transitory phenomenon of childhood. To continue with the results of this study: at the

TABLE 1

THE DEVELOPMENT OF ABILITY TO DETECT AND REJECT AUTISTIC FALLACIES AS A FUNCTION OF CHRONOLOGICAL AGE AND I.Q.

	Slightly Superior I.Q. Group Five Subjects at Each Age Level						
C.A. Years	6	7	8	9	10	11	12
I.Q. Range	107-114	103-119	97-106	103-118	105-121	108-114	108-122
I.Q. Mean	114	111	103	109	112	110	112
Per cent of autistic fallacies detected	20	25	50	55	65	85	90
	Exceptionally Superior I.Q. Group Five Subjects at Each Age Level						
C.A. Years	6	7	8	9	10	11	12
I.Q. Range	165-172	161-167	151-194	168-174	153-169	161-178	139-150
I.Q. Mean	167	164	172	170	158	169	143
Per cent of autistic fallacies detected	25	50	90	90	95	100	100

7-year level, three of the slightly superior I.Q. group accepted three, or 15 per cent, of the total fallacies presented. In one instance, the fallacy accepted was Number 2 and in the remaining instances, it was Number 3. At the 8-year level two, or 10 per cent, of the fallacies were accepted by two members of the "slightly superior I.Q. group" and one, or 5 per cent, was accepted by an "exceptionally superior I.Q." subject. In all three instances, the fallacy accepted was Number 3. At the 9-year level two, or 10 per cent, of all fallacies presented to the group were accepted by one slightly superior I.Q. subject. This subject accepted and supported fallacies Numbers 2 and 3. No other

TABLE 2

A SUMMARY OF MOORE'S RESULTS SHOWING THE DEVELOPMENT OF LOGICAL ABILITY AS A FUNCTION OF CHRONOLOGICAL AGE

205 Subjects with I.Q. Range from 90 to 110

C.A. Years	6	7	8	9	10	11	12	113 1st year college women
Per cent of reasoning items passed	23.1	24.8	32.1	43.1	51.1	56.0	63.2	88.0
Per cent of autistic fallacies detected	00.0	00.0	1.25	4.0	3.05	14.2	23.1	83.0
Per cent of logical fallacies detected	5.8	9.6	21.9	27.3	36.0	53.7	54.8	80.0

fallacies were accepted by the subjects of this report. These results appear to support the contention that autistic thinking in childhood is more a function of the content of the material presented to the thinker than of the growth of reasoning ability. It may be of interest that a significant proportion of the responses of subjects who accepted fallacy Number 3, which involves a connection between individual wrongdoing and coming world destruction, were attempts to use the fallacy as presented to explain the causes of the present war, which apparently was considered to be "the destruction that is coming on the world."

Summary and Conclusions

Seventy children ranging in C.A. from 6 to 12 years, with ten at each age level, have been given an autistic fallacies test devised by T. V. Moore. The procedure of administration of the test differed from Moore's in that it was preceded by certain selected items from Form L of the 1937 Revision of the

Stanford Binet. The subjects differed somewhat from Moore's subjects in that half of each age level group was slightly superior in intellectual status to his subjects and the remaining half were definitely superior.

The results obtained support the following conclusions:

1. There is no essential difference between the development of the ability to detect and reject autistic fallacies and the development of the ability to reason logically or to detect logical fallacies.

2. There is a close relationship between the ability to detect autistic fallacies and mental age since children of exceptionally high I.Q. made better scores on the test than did 113 first year college women tested by Moore.

3. There is no evidence to support a conclusion that "autistic reasoning is a transitory phenomenon of childhood."

REFERENCES

(1) Hollingworth, H. L. Psychology of thought. New York, D. Appleton Co., 1927.

(2) Huang, I. Children's conception of physical causality: a critical summary. J. Genet. Psychol., 1943, 63, 71-121.

(3) Moore, T. V. The reasoning ability of children in the first years of school life. Stud. Psychol. and Psychiat., Catholic Universtiy of America, 1929, 2, No. 2.

(4) Munn, Norman L. Psychological development. New York, Houghton Mifflin Co., 1938.

(5) Terman, L. M., and Merrill, M. A. Measuring intelligence, New York, Houghton Mifflin Co., 1937.

(6) Warren, H. C. Dictionary of psychology, New York, Houghton Mifflin Co., 1934.

STUDIES OF THE CENTER OF GRAVITY IN THE HUMAN BODY

CARROLL E. PALMER[1]

Introduction

The position of the center of gravity in the human body has been studied from various points of view by anatomists and physiologists for many years. The earlier investigators were primarily concerned with the theoretical significance of locating the center of mass of the body. Later workers have emphasized the importance of considering the effects of gravity in problems of the mechanics of posture and locomotion. More recently the center of gravity of the human fetus has been studied in connection with certain obstetrical problems. At various times the situation of the center of gravity has been considered an important factor in the estimation of various types of body build and body form. Although extensive studies have been made on the position of the center of mass of the human body, no adequate method has been described for the finding of this point and most of the studies have been based upon analysis of very few observations.

It was the aim of this research to develop an accurate and expedient method for the determination of the center of gravity in the living body and to apply this method to a sufficiently large series of cases to permit a statistical analysis of some of the more important influences which the force of gravity may have on the human body. It is believed that a study of this kind may throw some light upon various problems of the growth of the body and in particular to be of importance in connection with certain problems of the mechanics of child physiology as applied to motor activity and motor coordination. It is the purpose of the present paper to show detailed determinations of the

[1] Work upon this paper was begun during the writer's tenure as a Teaching Fellow, Department of Anatomy, University of Minnesota, and completed during his tenure (1928-1930) as a National Fellow for Research in Child Development, Committee on Child Development, National Research Council.

At the time of doing the study, the writer expressed his appreciation of Professor R. E. Scammon's guidance in every phase of this study, and of Professor J. E. Anderson's generous support; and his gratitude to Mr. E. N. Rosell, then Superintendent at Mooseheart, Illinois, for the opportunity to work at Mooseheart; and to the late Dr. J. D. Nichols, then resident physician at Mooseheart, and his staff, for the cooperation which was so graciously given.

CHILD DEVELOPMENT, Vol. 15, Nos. 2-3 (June-September, 1944)

center of gravity for a relatively large series of cases, with only brief references to certain historical aspects of the problem and a short description of the apparatus devised by the writer.[2]

Since the series of cases, with which this paper is concerned, included both sexes and all ages from birth to adulthood, it is believed to present for the first time comprehensive observations on the principal changes in the location of the center of gravity for the entire developmental period of postnatal life. A limited number of observations on fetal cadavers are also included; but the major emphasis is on living subjects.

The history of experimental attempts to determine a plane of gravity or the center of gravity of the human body goes back to the 17th century when Borelli (1680) reported his balance-board experiments and thus was the first investigator to report on even an approximation of the location of the transverse plane of gravity. The Webers, over 150 years later (1836), did the first quantitative work on the problem and were able to report for two subjects both the absolute height of the transverse plane above the soles, and its relative height, expressed as a percentage of body length or stature. The numerous subsequent workers who have attacked the problem have very generally done one of two things: 1) many have used only cadavers (adult) or fetuses placed in the intrauterine position, and 2) others have reported their findings in such a way that few are mutually comparable and even fewer give sufficient information to permit an exact anatomic location of the center. Furthermore, there has been little study of the course of change in the position of the center over the developmental periods of postnatal life. It has long been known that the center of gravity in the newborn is close to the posterior margin of the diaphragm, while in the adult it is in the second or third sacral vertebra. However, the course of its change in location and what factors affect that change have remained uninvestigated and few, if any, detailed observations have heretofore been available.

In general, methods and apparatuses have been devised to locate a single plane through the body which contains the center of gravity; in certain instances this has been a transverse section of the body (Borelli, E. Weber and W. Weber, Duncan; du Bois-Reymond; Barnum; Griffith; Scheidt; and Croskey, Dawson, Luessen, Marohn and Wright); in other instances this has been a frontal plane of the body (Meyer; Richer; Haycraft

[2]*For more complete details as to apparatus and for a review of the literature the reader is referred to: "Center of Gravity of the Human Body during Growth," by Carroll E. Palmer (Am.J.Phys.Anthropol., 1928, XI, 423-455).*

and Sheen; Reynolds and Lovett, Hesser; and Resmark). Nearly all the investigators have assumed that the midsagittal plane of the body passes through the center. However, two methods (Harless, and Braune and Fischer) have been devised for locating the point of gravity in the dead body. One method (Solis) has been developed for finding the position of the true center in the living body.

A study of all of these methods leads the present writer to the conclusion that none of them has proved satisfactory. Only the later workers in this field (Scheidt; and Croskey, Dawson, Luessen, Marohn and Wright) were sufficiently confident to make a study of more than a few cases, and Scheidt himself expressed the opinion that present methods were not adequate to handle the problem successfully. The researches of Solis are, however, exceptional. Without doubt his measurements are accurate and his results precise. Nevertheless, it must be admitted that his experiments were made with great care upon cooperative subjects and that such results could be obtained only under very favorable conditions.

A review of the aggregate results of the various investigators indicates the present status of this problem. As reported in the available literature, determinations of the position of the transverse plane of gravity have been made in a total of 760 subjects. Of this number the actual measurements have been published for 84 subjects of which 54 were fetal bodies placed in the intrauterine position. Of the remaining 30 cases, only 23 were living subjects. The data covering the position of the center of gravity in other planes include a total of 82 determinations. Again, 54 of these observations were made upon fetal specimens and an additional 7 were made upon dead bodies. If the prenatal period is excepted, it is apparent that, although a comparatively large number of determinations have been made, very few are available for further study and analysis. It is expecially regrettable that the extensive studies of Scheidt, and of Croskey, Dawson, Luessen, Marohn and Wright were published in such abbreviated form as to be practically useless for further study.

It appears to the writer that Griffith's study of the influence of gravity upon the fetal body has quite adequately solved most problems concerned with that period of development. Both the relative and actual positions of the center of gravity of the fetal body while in the intrauterine posture have been clearly demonstrated.

The location of the center of gravity in the mature and adolescent body has been fairly well established by the careful work of E. and W. Weber, Harless, Braune and Fisher, and

Solis. However, essentially nothing is known of the factors concerned with the very marked change in its location over the developmental ages nor of the influences which the force of gravity may have upon mechanical problems during infancy and childhood.

Methodology

Introductory Note

A review of previous methods and apparatuses used to determine the center of gravity of the human body has enabled the writer to establish certain criteria that he believes should be fulfilled if an adequate investigation is to be made of this problem. The fundamental points laid down in these criteria are as follows:

> The first point requires that the center of gravity be located in two-dimensional space. Careful consideration of this part of the problem has led to the conclusion that it is not feasible to attempt to locate the center of gravity in a sagittal plane. The human body is, of course, not perfectly symmetrical. In order to determine a sagittal plane through the center of gravity the subject must assume a symmetrical posture. Two factors are therefore involved, the actual (and usual) asymmetry of the body, and the errors introduced by asymmetry of posture. The difficulty of experimentally separating these two factors is so great that for the present no provision can be made for determining this plane. However, the two remaining planes, the transverse and frontal, which pass through the center should be located. In addition, it is important that both planes be determined while the subject is in the same position. If possible, both planes should be located simultaneously; at least, the subject should assume the same posture during the determination of each plane.
>
> The second point to be considered concerns the methods of expressing the position of the center. If comparisons are to be made, and if any considerable number of cases is to be studied, it is essential that the center be located with respect to certain well-defined anatomical landmarks. It will be important, also, to localize the center in a purely anatomical situation, but the great individual variability of organs and structures makes it of even greater significance to determine its position relative to the body as a whole.

The third criterion deals with the subjects to which the method may be applied. From several points of view it is desirable to study living subjects since if facts are to be determined concerning the influences of gravity upon the living, it is necessary to study living individuals. The effect of gravity upon the body is continuously present and if a comprehensive study is to be made, the method must be equally applicable to subjects of any age.

The fourth consideration involves the accuracy and general applicability of the method. Of prime importance is the accuracy which may be obtained. From a practical viewpoint, however, measurement of the center of gravity should be as precise as other bodily measurements. The general applicability of the method and apparatus is of great importance. If children are to be studied it is essential that determinations be made quickly and easily without a great deal of cooperation from, or manipulation of, the subject. The method described in this paper was finally evolved after consideration of all these points.

Apparatus

The apparatus designed in the present study utilizes the principle of moments of force about a fixed point. In general it is based upon the fundamental principles of the methods of du Bois Reymond, Scheidt, Reynolds and Lovett, and of Hesser, and combines the essential features of the apparatuses of all these investigators.

The apparatus itself consists of a rectangular steel frame, to the undersurface of which are attached two wedges or knife edges; one wedge acts as the fulcrum, the other as the force point. At one end of the steel frame is hinged a flat platform upon which the subject lies in the supine position. This platform is so constructed that it may be fixed firmly in three positions, either horizontal and parallel with the supporting frame or tilted in such a manner that the subject lying upon its surface is inclining at a known angle to the horizontal. When the subject lies in the horizontal position upon the platform, his transverse plane of gravity may be determined by the simple procedure of du Bois-Reymond or of Scheidt. When the platform is elevated into the inclined position, the location of the frontal plane of gravity may be calculated by a method analogous to that of Reynolds and Lovett or of Hesser. The determination of the position of the center of gravity in these two axes is shown diagrammatically in Figure 1, which is a schematic out-

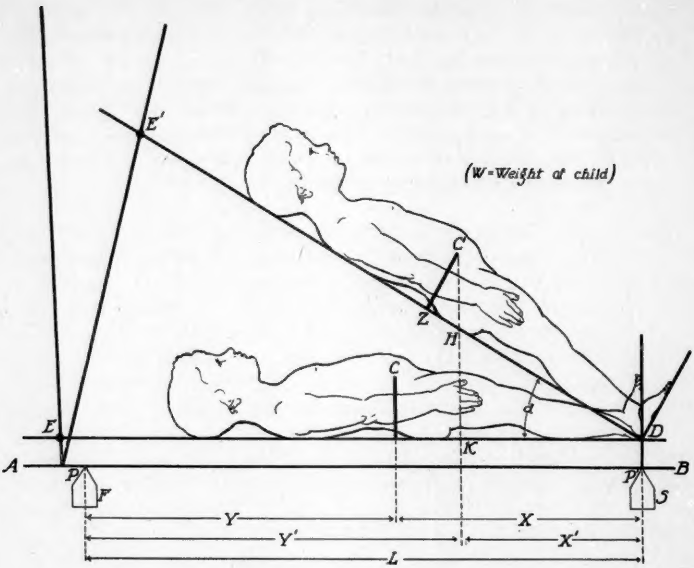

Figure 1. Method employed to determine the transverse and frontal planes through the center of gravity of the human body.

line drawing of the apparatus showing a subject in position. The line AB represents the cross-section of the rectangular steel frame to which is hinged the platform indicated by the line DE. The subject lies in the supine position upon the platform DE with his feet firmly against the upright footboard placed at D. The point of rotation of this platform is exactly at the point D. The wedge shown at the point P rests upon a fixed stationary support, while the wedge shown at the point P' rests upon the pan of a scale. The center of gravity of the subject is represented as C and C'. For the purpose of this description, it is assumed that the weight of the apparatus is negligible and that the weight supported by the wedges is due only to the weight of the body, W. The portion of this weight supported by the fixed wedge is represented as F, and that supported by the scale as S. The relative magnitudes of F and S, then, depend upon the position of the vertical plane of gravity; that is, the plane which passes vertically downward through the point C. The

nearer this plane approaches either wedge, the greater must be the weight which that wedge supports. The distance between the two wedges is indicated as L, and the distances from the vertical plane of gravity to either wedge are correspondingly indicated as X and Y. The distance X, therefore, marks the distance of the transverse plane of gravity above the soles of the feet. The proportional relationships between these factors may be expressed in various ways:

$$F : S :: X : Y \text{ or } W : S :: L : Y$$

From the second expression it may be seen that

$$SL = WY, \text{ and } Y = \frac{SL}{W},$$

$$\text{And because } X + Y = L, S = L - \frac{SL}{W}$$

Then, in this last equation: S equals the force upon the scale and can be experimentally determined; L is the distance between the wedges and is a constant factor; W is the weight of the body and can be directly determined. With these factors known, X, or the distance of the center of gravity above the soles of the feet, can be calculated.

The platform is now rotated through the angle α into the position shown as E'D. In this position the plane of gravity will fall vertically from the point C' and cut the horizontal at the point K. Under these conditions, X' represents the distance from the plane of gravity to the point P', while Y' represents the corresponding distance to the point P. In this position a new value of S will be obtained and the value of X' can be calculated by means of the same formula used to determine X. After the values of X and X' have been found, the distance C'Z or the distance of the center of gravity above the surface of the platform upon which the subject is lying, can be calculated as follows:

In the triangle DHK:

α = the angle through which the platform is rotated.

$$\cos\alpha = \frac{KD \text{ (or } X')}{HD} \text{ and,}$$

$$HD = \frac{X'}{\cos}$$

In the triangle ZHC':

$$ZH = ZD \text{ (or } X) - HD \left(\text{or } \frac{X'}{\cos\alpha}\right)$$

$$ZH = X - \frac{X'}{\cos\alpha}$$

$$\text{But } \tan\alpha = \frac{ZH}{ZC'} \text{ or}$$

$$ZC' = \frac{ZH}{\tan\alpha} \text{ therefore,}$$

$$ZC' = \frac{X - \frac{X'}{\cos\alpha}}{\tan\alpha}$$

X and X' were determined in the initial calculations and the trigonometric functions of the angle α are known constants. Therefore, the distance of the center of gravity above the upper surface of the platform, or the position of the frontal plane of gravity, can be determined.

The technical details of the apparatus, as used for determining the center of gravity in infants and small children, have been described in full detail elsewhere (in the paper previously cited). The apparatus, as changed to be suitable for use with adults, is shown in Figure 2. The basic principles are the same as those embodied in the original apparatus.

Technique of Determination

A detailed description of the actual procedure for making a determination of the center of gravity is given here to demonstrate the facility with which this method and apparatus may be applied to the study of living subjects.

The subject is first placed in the supine position upon the platform of the gravity device in the manner shown diagrammatically in Figure 1. The heels are placed together, firmly against the footboard. The legs are together and completely extended. The trunk lies flat upon the platform. The arms are placed along the trunk with the palms flat upon the thighs. The head is held straight with the face horizontal.

A counterweight (see Figure 2) is turned to its proper position to balance the apparatus, the screw carrying the scale point is adjusted to level the apparatus and compensate for the depression of the scale. As soon as these adjustments have been made, the weight upon the scale is read.

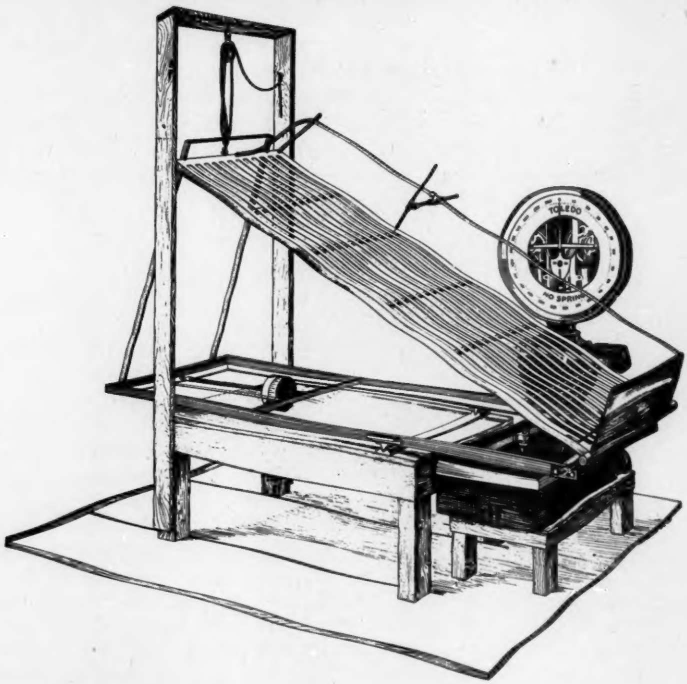

Figure 2. Revised apparatus for determining the transverse and frontal planes through the center of gravity.

The flat platform is then moved to the first inclined position. The counterweight is turned to its proper setting for this angle of elevation, the screw scale point is adjusted to level the apparatus, and the scale reading is again recorded.

The platform is moved to the second inclined position and, after again adjusting the level and counterweight, the third reading is recorded.

It is important that the subject does not alter his position during the few minutes required to obtain these three readings.

Tbe subject is then removed from the apparatus; the table carrying the gravity device is rolled away from the scale; and the natural body weight of the subject is determined by means of the same scale.

Thus four scale readings have now been obtained: body

weight, the weight on the apparatus in the horizontal position, and the two weights in the inclined positions. These four values are the only variables necessary for the calculation of both the transverse and frontal planes of gravity. The details of the actual computation are not significant except to show that they may be simplified to a considerable extent by the use of algebraic and trigonometric combinations. The final formulae in which substitutions are made are given in order to demonstrate the actual simplicity of the calculations.

Distance of transverse plane from soles $= 74.8 \left(1.599 - \frac{S0^{\circ}}{W}\right)$,

Distance of frontal plane from back (25°) $= 185.0 \frac{S25^{\circ}}{W} - 169.2 \frac{30^{\circ}}{W} - 25.26$ cm.,

Distance of frontal plane from back (30°) $= 143.8 \frac{S30^{\circ}}{W} - 122.8 \frac{S0^{\circ}}{W} - 33.54$ cm.

Where $S0^{\circ}$ = the scale reading in the horizontal position,
and $S25^{\circ}$ = the scale reading in the 25° position,
and $S30^{\circ}$ = the scale reading in the 30° position,
and W = the weight of the body.

Figure 3 shows the photographs of several children in whom the center of gravity has been determined. The photographs on the upper and those on the lower line show the position of the transverse plane of gravity marked upon the body by means of a skin pencil. In the central photograph the position of the frontal plane is shown by a vertical line.

Precision of Apparatus

The accuracy of determinations of the center of gravity has been carefully investigated. Theoretically, the precision of the apparatus is dependent upon these factors: 1) the precision of the scale used with the apparatus, and 2) the accuracy with which the subject may be placed in position upon the platform. The variability of the center of gravity due to inaccuracies of the scale was worked out, in part, before the apparatus was constructed.

At first a small scale was used for determining the center of gravity in infants and young children. It was graduated in 10 gm. intervals and it was assumed, after some investigation, that weighings could be made within an accuracy of 25 gm. The effect of this degree of precision was then calculated and the

Figure 3. Photographs of 4 children showing the position *of the planes of gravity. The central figure shows the position* of both the transverse and frontal planes marked upon the lateral aspect of the body.

Table 1

Theoretical estimates of experimental error due to use of small scale

Age	Stature*	Weight	Plane of gravity			Maximum theoretical change of center of gravity produced by variation of 25 gm.		
			From soles	From 30°	back 45°	From soles	From 30°	back 45°
	(cm.)	(kg.)	(cm.)	(cm.)	(cm.)	(cm.)	(cm.)	(cm.)
1 mo.	52.8	3.940	31.27	8.41	-	0.54	2.08	-
1 yr.	75.8	10.950	44.20	7.22	6.98	0.16	0.64	0.46
4 yr.	104.0	18.025	59.19	6.69	6.56	0.07	0.29	0.16

*Crown heel measurement

Table 2

Theoretical estimates of experimental error due to use of large scale

Age	Stature	Weight	Plane of gravity			Maximum theoretical change of center of gravity produced by variation of 1/8 lb.		
			From soles	From 30°	back 45°	From soles	From 30°	back 45°
(yr.)	(cm.)	(lb.)	(cm.)	(cm.)	(cm.)	(cm.)	(cm.)	(cm.)
3	101.2	33 1/8	58.13	6.02	6.09	1.23	1.70	1.06
7	115.1	54 3/4	63.92	7.00	6.89	0.52	0.94	0.66
13	160.0	87 7/8	90.14	7.91	8.03	0.20	0.60	0.40
24	179.7	165 1/2	100.45	9.82	9.96	0.09	0.31	0.22

results of three theoretical examples are shown in Table 1. It was found, for instance, that a deviation of 25 gm. upon a 4 kg. subject resulted in a change of about 0.5 cm. in the position of the transverse plane of gravity. This amount of variation in the scale caused a much greater deviation, about 2.0 cm., in the theoretical frontal plane of gravity. In larger subjects the effect of this deviation becomes progressively less so that, in a child weighing 20 kg., the variation in the transverse plane is only 0.07 cm. and in the frontal plane it is less than 0.3 cm. A larger scale used with older subjects was assumed to be accu-

rate within 1/8 lb. (under 60 gm.). The results for three theoretical cases are shown in Table 2. In a child weighing 88 lbs. the effect of a variation of 1/8 lb. was found to be approximately 0.2 cm., when translated into terms of the distance of the transverse plane of gravity from the soles; and to be approximately 0.6 cm. in terms of the distance of the frontal plane from the back.

Thus it was shown that it is theoretically possible to determine the position of the transverse and frontal planes of gravity with a high degree of precision. When it is considered that the most reliable linear measurement of the body, standing height, can be made with a precision of only 0.5 cm. (Boyd '29, Todd '25, Todd and Lindala '28), the possibilities of this apparatus appear to be well worthy of investigation.

The second factor, the variability due to inconstancies of the position of the subject upon the apparatus, could not be ascertained theoretically. It was desirable to test this point as well as to check, experimentally, the deviations produced by inaccuracies of the scale. In order to accomplish this, and also to find any other possible source of error, the following experiment was carried out.

Two large wooden blocks were obtained, and a series of observations upon them was statistically analyzed. These experimental objects were solid blocks of pine. Block 1 measured 508 mm. in length, 170 mm. in breadth, and 189 mm. in height. Block 2 measured 620 mm. in length, 96 mm. in breadth, and 96 mm. in height.

The centers of gravity of these two blocks were determined by means of the balancing method of Borelli and also by means of the suspension method of Braune and Fischer. Several observations were made by both of these methods and it was possible to make a close approximation to the position of the center of gravity. The center of Block 1, by these methods, was found to be 254 mm. from a marked edge, for the transverse plane, and 94 mm. from the marked edge for the frontal plane. The center of Block 2 was 312 mm. from a marked edge for the transverse plane and 48 mm. from that edge for the frontal plane.

A series of measurements was next made upon each block using the apparatus designed for this study. The results of these observations are shown with the means, their probable errors, ranges, mean deviations, standard deviations, and coefficients of variability with their probable errors, in Table 3. This table shows that the transverse plane of gravity in Block 1 is 254.3 mm. from the marked edge, 94.0 mm. from this edge in the frontal plane as determined in the first inclined position, and 94.2 mm.

Table 3

Summary of experimental findings on the variability of the inert test objects

Block No. and item		Mean	Range	Mean deviation	Standard deviation	Coefficient of variability (percent)
1	Weight	9867.3 ± 0.77 gm.	25 gm.	5.18 gm.	6.29 gm.	0.064 ± 0.0055
2	Weight	4054.8 ± 0.80 gm.	20 gm.	5.55 gm.	6.52 gm.	0.161 ± 0.0140
1	Scale reading, horizontal	15317.3 ± 1.83 gm.	70 gm.	12.00 gm.	14.87 gm.	0.097 ± 0.0084
2	Scale reading, horizontal	5613.2 ± 1.44 gm.	35 gm.	10.50 gm.	11.72 gm.	0.209 ± 0.0182
1	Scale reading at 30°	17614.1 ± 1.69 gm.	60 gm.	11.66 gm.	13.72 gm.	0.079 ± 0.0068
1	Scale reading at 45°	19330.8 ± 2.15 gm.	65 gm.	15.50 gm.	17.47 gm.	0.090 ± 0.0078
2	Scale reading at 30°	6378.7 ± 1.59 gm.	40 gm.	11.27 gm.	12.90 gm.	0.202 ± 0.0176
2	Scale reading at 45°	7081.5 ± 1.67 gm.	40 gm.	11.86 gm.	13.60 gm.	0.192 ± 0.0167
1	Center of gravity from end	254.3 ± 0.05 mm.	1.6 mm.	0.349 mm.	0.420 mm.	0.165 ± 0.0144
2	Center of gravity from end	313.0 ± 0.06 mm.	2.0 mm.	0.396 mm.	0.507 mm.	0.162 ± 0.0141
1	Center of gravity from side at 30°	94.0 ± 0.06 mm.	1.9 mm.	0.341 mm.	0.452 mm.	0.481 ± 0.0418
1	Center of gravity from side at 45°	94.2 ± 0.06 mm.	1.7 mm.	0.254 mm.	0.458 mm.	0.485 ± 0.0422
2	Center of gravity from side at 30°	47.5 ± 0.09 mm.	3.2 mm.	0.580 mm.	0.734 mm.	1.545 ± 0.1372
2	Center of gravity from side at 45°	47.3 ± 0.08 mm.	2.9 mm.	0.487 mm.	0.611 mm.	1.291 ± 0.1137

from the edge as determined in the second inclined position. In Block 2 the transverse plane is 313.0 mm. from the marked edge, 47.5 mm. from the edge in the frontal plane as determined by the first inclined position, and 47.3 mm. from the edge as determined by the second inclined position.

Further examination of this table shows the precision that may be expected in determinations of the center of gravity of inert bodies by means of this apparatus. It is shown that the simple weights of the blocks vary, on the average, approximately 5 gm., with a standard deviation of only slightly more than 6 gm. These figures, and subsequent observations with this scale, indicate that the actual error is well within the assumed 25 gm. range. The weights recorded when the apparatus itself is incorporated in the determination show a greater variability, but in no case does the standard deviation exceed 20 gm. The distribution of these deviations gives no clue to the actual causes of the variations, but it does demonstrate that the errors are noncumulative.

It will be seen that when these fluctuations in weight are read into the actual linear deviations of the centers of gravity, the largest standard deviation (frontal distance of the center of gravity, Block 2) is .734 mm. Or, expressed in another fashion, the center of gravity in inert objects may be localized within a circle having a radius of three-fourths of one millimeter. It is not assumed that measurements made upon living human beings, especially upon children, can be made with as great precision as upon these inert objects. However, it seems justifiable to conclude that the figures given above represent the errors occasioned by purely mechanical and manipulatory factors and that the reliability of this method and apparatus has been fairly well established by actual experimental measurements. Determinations may be made upon living subjects with the assurance that when the measurements show greater variations, the increase is due to the greater variability of biological material.

The final test of the reliability of this method and apparatus was made by means of seriatim measurements upon three living subjects. These subjects were young boys - Test Case 1 was 8 years and 10 months old, weighed 29.15 kg. and was 131.1 cm. in height; Test Case 2 was 12 years and 10 months old, weighed 37.4 kg. and was 149.8 cm. in height; Test Case 3 was 14 years and 9 months old, weighed 46.95 kg. and was 158.3 cm. in height. Ten successive observations were made upon each subject. Each series of observations consisted of measurements of body weight, standing height, sitting height, the distance of the transverse plane of gravity from the soles, and the distance of the frontal plane from the back as determined in the

Table 4

Seriatim observations and measures of variability on position of center of gravity and certain body measurements

Test Case 1

Number	Stature	Sitting height	Weight	Plane of gravity			
				From soles	From 25°	back 30°	Percentage height from soles
	(cm.)	(cm.)	(kg.)	(cm.)	(cm.)	(cm.)	
1	131.8	72.4	29.14	76.1	7.6	8.4	57.0
2	131.1	73.7	29.14	75.2	8.2	7.7	57.4
3	131.4	73.0	29.20	75.2	7.1	7.4	57.2
4	131.1	71.1	29.14	74.5	7.3	7.1	56.8
5	130.8	70.8	29.14	74.8	7.2	7.3	57.2
6	131.1	70.8	29.20	74.7	6.7	7.2	57.0
7	130.5	72.4	29.14	75.1	7.9	8.1	57.5
8	130.8	71.4	29.14	75.1	7.9	8.1	57.4
9	130.8	70.9	29.14	75.2	7.5	8.3	57.5
10	131.4	72.4	29.14	74.9	7.5	7.5	57.0
Range	1.3	2.9	0.06	0.7	1.5	1.3	0.7
Mean	131.08	71.89	29.15	74.98	7.49	7.71	57.2
Average deviation	0.27	0.85	0.02	0.20	0.33	0.40	0.22
Standard deviation	0.38	0.88	0.03	0.24	0.43	0.47	0.24

two inclined positions, 25° and 30°. The results of this experiment are recorded in Tables 4, 5, and 6. The biometric constants which were considered significant were calculated and are recorded in the tables. A review of this material, and especially of the statistical constants, indicates the reliability with which the method can be applied to the living. Attention is directed, in particular, to a comparison of the standard deviations of standing height and of the height of the transverse plane of

Table 5

Seriatim observations and measures of variability on position of center of gravity and certain body measurements

Test Case 2

Number	Stature (cm.)	Sitting height (cm.)	Weight (kg.)	Plane of gravity: From soles (cm.)	Plane of gravity: From back 25° (cm.)	Plane of gravity: From back 30° (cm.)	Plane of gravity: Percentage height from soles
1	150.2	76.2	37.41	86.0	8.8	8.9	57.3
2	150.2	75.6	37.35	85.6	8.3	8.6	57.0
3	149.9	76.5	37.46	85.6	6.6	7.2	57.1
4	150.2	75.9	37.46	86.3	8.7	8.8	57.5
5	150.5	76.5	37.35	85.6	8.0	8.6	56.9
6	148.6	75.9	37.41	86.0	8.8	9.5	57.9
7	150.2	75.9	37.35	85.7	8.3	8.5	57.1
8	149.9	76.5	37.41	86.0	9.1	9.0	57.4
9	150.2	75.2	37.46	85.8	8.2	8.2	57.1
10	149.2	76.2	37.35	85.8	9.1	8.9	57.5
Range	1.9	1.30	0.11	0.7	2.5	2.3	1.0
Mean	149.91	76.04	37.40	85.84	8.39	8.62	57.28
Average deviation	0.37	0.30	0.04	0.20	0.51	0.32	0.24
Standard deviation	0.57	0.38	0.05	0.23	0.74	0.38	0.31

gravity. These measurements are themselves directly comparable and, as is shown in the tables, their standard deviations are of the same order of absolute magnitude.

Measurements of the frontal plane of gravity show slightly more variability. The standard deviations are greater, absolutely, than those of either standing height or the height of the center of gravity. They are, however, considerably smaller than the standard deviations of measurements of sitting height.

Table 6

Seriatim observations and measures of variability on position of center of gravity and certain body measurements

Test Case 3

Number	Stature	Sitting height	Weight	Plane of gravity			
				From soles	From 25°	back 30°	Percentage height from soles
	(cm.)	(cm.)	(kg.)	(cm.)	(cm.)	(cm.)	
1	158.7	83.8	45.98	89.9	9.5	9.7	56.6
2	158.1	85.7	46.04	89.6	8.8	9.0	56.7
3	158.4	86.4	45.93	90.1	10.0	9.8	56.9
4	158.1	84.5	45.93	89.1	8.8	9.1	56.4
5	157.8	84.5	45.98	89.5	8.9	9.1	56.7
6	158.4	83.8	45.98	89.7	9.1	9.4	56.6
7	158.1	84.5	45.93	89.4	8.7	8.6	56.5
8	158.4	84.8	45.93	89.3	8.6	8.9	56.4
9	158.1	84.5	45.93	89.6	9.1	8.8	56.7
10	158.4	85.7	45.93	89.6	8.6	9.1	56.6
Range	0.9	2.6	0.09	1.0	1.4	1.2	0.5
Mean	158.25	84.82	45.95	89.58	9.01	9.15	56.61
Average deviation	0.27	0.66	0.03	0.20	0.33	0.27	0.11
Standard deviation	0.31	0.86	0.04	0.29	0.44	0.38	0.15

__Summary__

The manner in which this apparatus satisfies the criteria set up at the beginning of this study may be summarized as follows:

__First__, it is possible to determine a transverse and a frontal plane of the body which pass through the center of gravity. These planes may be determined without changing the position or the posture of the subject, although the exact situation of the body is changed with respect to the axis of the earth.

__Second__, the position of the center of gravity is expressed in terms of its linear distance from certain fundamental landmarks. The transverse plane is located as a linear distance from the plane which passes through the soles of the feet. The frontal plane is similarly located as a linear distance from a flat surface upon which the subject lies. By making other bodily measurements, it is possible to orient the center with respect to other anatomical landmarks. In a living subject such a definition of the location of the center must necessarily be sufficient; in a dead body the actual anatomical situation may be found by cutting sections through the body or by dissection.

__Third__, the method may be applied with equal facility to either living or dead subjects. The method can also be applied to subjects of any age, from infancy to adulthood.

__Fourth__, by means of this apparatus it is possible to determine the position of the transverse plane of gravity with the same precision as it is possible to determine the linear body measurement or standing height. The frontal plane can be determined as precisely as sitting height can be measured. The time required to determine the center of gravity is less than five minutes and only the very minimum of cooperation of the subject is necessary.

Material

The material for this paper consists of a series of measurements upon 1,172 living subjects - 596 males, and 576 females - whose ages range from birth to 20 years, and upon 18 fetal cadavers having body lengths of 25 to 55 cm. This material was collected in Minneapolis and St. Paul, Minnesota,

and Mooseheart, Illinois. The collection of data was begun in the spring of 1927 and completed in the fall of 1929. The measurements taken were selected with special reference to their application in this particular study and include certain external dimensions of the body, as well as determinations of the position of the transverse and frontal planes of gravity. With these measurements it is possible to locate the center of gravity anatomically, to correlate various dimensions with the position of the center, to reconstruct the body form of any individual or of any composite group, and to make other comparisons and analyses.

The determinations of the two planes of gravity were made according to the procedure already described. A record was thus obtained of the distance of the transverse plane of gravity above the soles, and that of the frontal plane from the back, as measured in two inclined positions.

The other dimensions and data recorded for each individual, and the methods of obtaining them, are summarized briefly as follows:

Age. The age of each subject was determined to the nearest month and recorded in years and months. For example, all children between the ages of 9 1/2 and 10 1/2 months were grouped as 10 months of age.

Weight. The weight of the body was required for the calculation of the center of gravity and was taken as described in the discussion of methods. The weights of the small children were obtained by means of a small 23 kg. scale used with the original apparatus. This scale was graduated by 25 gm. intervals and readings were estimated to the nearest 10 gm. The weight of the body was recorded in kilograms. The weights of the older subjects were obtained by means of a large 250 lb. scale used when the apparatus was changed. Weights were read to the nearest 1/8 lb. and avoirdupois weights were then converted to metric equivalents and also recorded in kilograms. All weights recorded are of nude subjects with the exception of those for girls over 9 years of age. These older girls were clothed in light cotton swimming suits which weighed, quite uniformly, 0.25 kg. Corrections for the weight of these suits have been made in all analyses except in the actual computations of the center of gravity.

Length. Measurement of the crown-heel, or vertex-planta, dimension was made by means of a measuring rod attached to the gravity apparatus. This measurement, as well as measurements of shoulder and pubic heights, and arm and leg lengths, was made with the subject in the same supine position upon the apparatus as that employed for the actual center of gravity

determinations. The details of this position have been described and it is only necessary to repeat here that the feet were placed firmly against the footboard. The pointer of the slider-arm of the measuring rod was placed very lightly upon the uppermost point of the crown to establish the upper end-point of the measurement.

Pubic height. This dimension is the horizontal linear distance from the plantar surface to the soft tissues directly over the superior anterior border of the symphysis pubis in the midline.

Leg length. This dimension is the horizontal linear distance from the plantar surface to the superior external border of the greater trochanter. In every case the measurement was made to the left trochanter.

Arm length. The length of the arm was determined indirectly in this study. The linear distance from the plantar surface to the tip of the third digit of the left hand, the medio-plantar distance, was measured. This value was subtracted from shoulder height (the standard acromion-planta length) and the remainder recorded as the length of the arm.

Stature. This dimension was taken in the manner described by Hrdlička ('20) and was recorded for all children who were able to stand erect. Measurements of most of the young children were made by means of an anthropometer graduated in metric units and set into a large concrete base. All of the older subjects and a few of the younger ones were measured by means of an especially constructed upright anthropometer graduated in English units of length. Measurements were made to the nearest 1/8 in., converted into metric equivalents, and recorded in centimeters.

Sitting height. This dimension is a trunk, or crown-rump, length; it was determined according to the method described by Hrdlička ('20) for obtaining sitting height. For all cases a uniform seat 44 cm. in height and the anthropometers for the determinations of stature were used. All measurements were converted into centimeters. In very young infants this measurement was made by means of a small anthropometer with the subject supine. In the latter cases the distance between the vertex and the ischial tuberosities was recorded as sitting height.

Anteroposterior diameter of chest. This diameter was taken at the level of the apex of the costal angle as the straight-line distance between the xiphisternal junction and the skin of the back in the midline. Care was taken to maintain the caliper in a horizontal plane. End-points were marked with moderate pressure and the readings taken at the midpoint between normal inspiration and expiration.

Transverse diameter of chest. The transverse diameter of the chest was measured in the same horizontal plane as the anteroposterior diameter. Similarly, moderate pressure was used to establish the margins of the chest and the measurement was taken at the midpoint of normal respiratory motion.

Anteroposterior diameter of pelvis. This dimension represents the standard external conjugate, or sacro-pubic, diameter and was taken as the linear distance between the soft tissues over the upper margin of the symphysis pubis and the soft tissues directly over the fossa below the spine of the last lumbar vertebra. Firm pressure was employed to mark the end-points of this measurement.

Transverse diameter of pelvis. The standard intercristal diameter was taken for this dimension. It was represented as a straight-line measurement, in the transverse plane, between the widest portion of the iliac crests. The points of the caliper were placed on the soft tissues over the outer lips of the crests and moved dorsally and ventrally until the widest point was found. Moderate pressure was used to establish the end-points of the measurement.

All measurements were of nude subjects except for the older girls who were clothed as described above in light-weight swimming suits. No correction of the diameters was made for the effect of this clothing. In view of the large experimental error of these measurements the effect of this clothing was considered negligible.

It was not possible to obtain the complete series of measurements of the entire group of 1200 individuals. However, age, stature or length, weight, and the planes of gravity were obtained in every case, and all the measurements were obtained for approximately 80 per cent of the group.

Subjects

This attempt to study the center of gravity during the whole of the developmental period required the collection of subjects from many different sources. The institutions and organizations which have cooperated in furnishing subjects, and a brief description of the data obtained from each source, are as follows:

The Institute of Child Welfare, University of Minnesota. The Institute of Child Welfare was of great help in the development of this research program. All of the early experimentation with methods and apparatuses was carried on there and the Institute bore most of the expense of the project. The nursery school division furnished subjects during a year spent in preliminary investigation. The nursery school and kindergarten

divisions also supplied nearly the entire group of children between the ages of 2 and 6 years. In addition, a special infant study sponsored by the Institute furnished a group of infants under one year of age.

The City of Childhood, Mooseheart, Illinois. This large orphanage of the Loyal Order of Moose was of great service in the prosecution of this program. The gravity device was sent to Mooseheart where the writer was given almost unlimited facilities with which to study normal children. A very large proportion of the measurements described here were made at this institution upon a group of 1000 children. The age range of these subjects extended from approximately 2 to 20 years.

The Salvation Army Maternity Home, St. Paul, Minnesota. A group of 12 infants whose ages ranged from 1 week to 3 months was studied.

The Jean Martin Brown Home for Children, St. Paul, Minnesota. This home furnished a group of 15 children ranging from 1 month to 9 years in age.

The Pediatric Department at the Minnesota University Hospital. A few normal children were obtained from the pediatric wards of the hospital.

The Department of Pathology and the Department of Obstetrics and Gynecology at the University of Minnesota. An attempt was made to extend this study into the prenatal period in order to determine, if possible, any change in the position of the center of gravity before or at the time of birth. Eighteen fetuses, with crown-heel measurements ranging from 25 cm. to 55 cm., were obtained through the courtesy of these departments, and each was examined as soon as possible. Each body was placed upon the apparatus in the supine position with legs and arms extended and tied into position in order to insure uniform posture. The planes of gravity were then determined by precisely the same procedure as that employed for living subjects.

In addition to these sources of material there were a few children who were brought individually to the laboratory where determinations were made.

Among the live subjects, in this study only those that appeared normal were used. No physical examination was made to ascertain "normality" but the entire series was collected with the view of obtaining a sample of the average population excluding the obviously pathological.

All subjects were Caucasian, but no records were taken of parentage, nationality, or occupational status. The nearly 200 individuals examined in St. Paul and Minneapolis furnished a fair cross-sectional sample of the population of that vicinity. A

Table 7

Distribution of living individuals with respect to geographic origin

State	Males	Females	Both sexes
Arkansas	0	3	3
Arizona	1	3	4
California	15	6	21
Colorado	3	4	7
Connecticut	4	2	6
Florida	4	8	12
Georgia	1	0	1
Idaho	5	5	10
Illinois	82	62	144
Indiana	40	42	82
Iowa	12	12	24
Kansas	12	8	20
Kentucky	5	2	7
Louisiana	3	2	5
Maine	3	3	6
Maryland	3	1	4
Massachusetts	6	7	13
Michigan	6	7	13
Minnesota	107	119	226
Missouri	4	2	6
Montana	3	4	7
Nebraska	2	1	3
New Hampshire	7	3	10
New Jersey	9	12	21
New Mexico	0	1	1
New York	25	14	39
North Carolina	6	7	13
Ohio	31	23	54
Oklahoma	2	6	8
Oregon	3	7	10
Pennsylvania	103	117	220
Rhode Island	3	1	4
South Carolina	1	1	2
South Dakota	4	1	5
Tennessee	3	3	6
Texas	1	1	2
Utah	8	10	18
Vermont	2	3	5
Virginia	6	9	15
Washington	7	10	17
West Virginia	24	20	44
Wisconsin	20	19	39
Wyoming	9	5	14
Total	596	576	1172

large portion of the Minnesota group were of Scandinavian or German descent. Many of the subjects obtained from the University district were from the upper socioeconomic classes, but those from the orphanages were generally from the lower occupational groups.

The children studied at Mooseheart were largely from the lower economic strata. The nationalities of this group of children were extremely varied and practically every European stock was well represented. Nearly every section of the United States sends orphans to this institution. Although no detailed classification was possible, the general geographic distribution, as regards the part of the United States in which the subjects originally lived, is shown in Table 7. The table includes the data actually collected in Minnesota. The wide geographic distribution indicates, to some extent, the degree to which this sample represents a general cross-section of the population of the United States.

The distribution of the subjects according to age and sex is shown in Table 8. Age, in this instance, was divided into yearly intervals. An individual's age was assumed to change on his birthday; for example, all subjects from 5 up to 6 years of age were classified in the 5-year-old group. All fetal cases were placed in the "prenatal" group.

The distribution of this material shows that few subjects in the first two years of life were obtained. Some difficulty was experienced in getting such children, especially in the group between 1 and 2 years of age. No organization was found from which they might be available, and it seemed necessary, therefore, to bring most of them individually into the laboratory. That procedure was not satisfactory. In many instances the child became so frightened that it was impossible to make a careful examination. All questionable cases were rejected. Those few individuals who do represent this group were carefully measured, however, and the data are, therefore, considered reliable.

It will be noted that the period about the time of puberty is well represented. A definite attempt was made to obtain as many cases as possible in this group in order that changes associated with puberty, especially sex changes and differences, might be more clearly brought out.

While it is not assumed that this group of approximately 1,200 children represents a true random sample of the developing child in the United States, it is believed that a sufficiently large and diverse group has been studied to establish preliminary standards and "norms" of the position of the center of gravity during the growing periods.

In this paper only part of the material actually collected will be used since the analysis is limited to consideration of the observations upon age, stature, weight, sitting height, pubic height, arm and leg lengths, anteroposterior diameters of chest and pelvis, and the distances of the center of gravity above the soles and from the back. Tables 9 and 10 show the original observations upon 596 living males and 576 living females. Observations upon the dead fetuses are given in Table 11.[3]

Table 8

Distribution of cases with respect to age

Age interval (yr.)	Males	Females	Both sexes
Prenatal	8	10	18
0 - 1	17	17	34
1 - 2	11	3	14
2 - 3	16	21	37
3 - 4	27	24	51
4 - 5	34	27	61
5 - 6	40	27	67
6 - 7	21	22	43
7 - 8	41	24	65
8 - 9	32	33	65
9 - 10	37	33	70
10 - 11	36	37	73
11 - 12	53	40	93
12 - 13	53	46	99
13 - 14	41	57	98
14 - 15	30	52	82
15 - 16	32	46	78
16 - 17	35	30	65
17 - 18	20	28	48
18 - 19	16	5	21
19 - 20	2	4	6
20 - 21	2	0	2
Total	604	586	1190

[3]*For convenience, Tables 9, 10 and 11 are placed at the end of the paper.*

Findings and Discussion

<u>Position of Transverse Plane of Gravity</u>

There are, in general, three more or less standardized methods of presenting and analyzing the type of material obtained in this study. The first and oldest method involves the use of an index or percentage to express the relationship between variable factors. The second method employs various indices of correlation to establish degrees of concomitance and association. The third method interprets relationships by means of graphic and analytic expressions. The efficacy of each of these procedures will be shown in an introductory study of the position of the transverse plane of gravity as it is related to total body length.

Since E. and W. Weber in 1836 made the first quantitative measurement upon the center of gravity, nearly every investigator of this problem has expressed the distance of the center of gravity from the soles in the form of an index or a per cent of the total body length. Many previous studies do not definitely state the body length dimension used in the calculation of the index or percentage height. In certain instances the linear crown-heel dimension measured in the supine position was used, in others, the stature, or standing height, dimension measured in the erect position was used. The well-known differences between these measurements make accurate comparisons difficult.

It is necessary to establish definitely the length dimension to be used in the calculation of the index, and this is especially necessary if precise comparisons are to be made within the whole range of the developmental period.

Boyd has shown the reliability of various length measurements and has clearly indicated that the standing height or stature dimension furnishes the best measurement of the total linear size of the body. It cannot, of course, be employed in the measurement of infants. The determination of any total length measurement in infancy, however, involves the straightening out of the legs against active flexion. This flexion tends to decrease the magnitude of any length dimension and raises the question of whether a measurement taken in the supine position upon infants is comparable with similar measurement upon older children where the flexion tendency has disappeared. It seems justifiable to conclude that part, at least, of the usual difference between standing height and crown-heel length may be counteracted by this flexion of the legs. Accordingly, it was finally decided to use the standing height dimension for all children in whom it was possible to obtain a measure in the erect position, and to use the crown-heel dimension taken in the

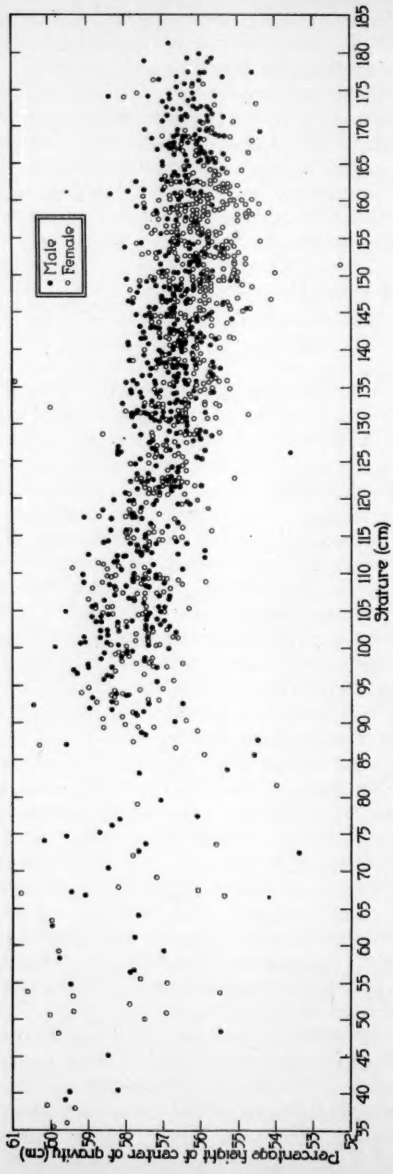

Figure 4. The index or percentage height of the center of gravity plotted against stature, from approximately the sixth fetal month to maturity.

supine position for the remainder of the group. These measurements are simply combined and the subsequent use of the term 'stature' in this paper will be understood to mean the combination of these two dimensions whenever it is necessary to use a body length measurement for the whole of the developmental period. This procedure is doubtless open to criticism but it has been adopted because some compromise is necessary, and it is justified on the grounds that it seems to introduce the least amount of error. The index, or percentage height, of the center of gravity is thus obtained by the following formula:

$$\frac{\text{Distance of center of gravity from soles}}{\text{Stature (standing height where possible and crown-heel in infants)}} \times 100 = \text{Index or percentage height.}$$

In Figure 4 the index, or percentage height, of the center of gravity is plotted on the ordinate and stature on the abscissa. In this graph stature is used in the same sense as for the calculations of the ratio. The entire series of 1200 observations, including the 18 prenatal cases, is shown in this graph. The belief of early workers, that the height of the center of gravity is closely related to body length, is substantiated. The index is fairly constant during the whole of the developmental period from about the sixth fetal month to maturity. This material shows considerable variability before the first two years of postnatal life; after that time the variability is reduced and remains low during the rest of the growing period. The greater dispersion of the first period is probably due to the greater experimental error where the actual variability of the material is overshadowed by the errors of measurement.

Despite the fluctuations in the earlier years almost the entire series is included between the indices 54.5 and 59.5, and a rough count shows that 1121 of the 1200 cases are included between 55.0 and 59.0, a range of 4 per cent. The notable constancy of this index is thus shown by the fact that approximately 95 per cent of the entire group extend over a range of only 4 per cent.

Review of the literature has indicated that similar findings are reported by other investigators and that in this respect the results of the present work are well in accord with the data already published upon the problem.

Further study of Figure 4 shows a definite trend even within the small range of 4 per cent. The trend is not clean-cut until the second year of postnatal life but at that time it becomes well established and is definite throughout the remainder of the growing period. As stature increases from approxi-

mately 85 cm. to 180 cm. the relative height of the center of gravity definitely decreases. Analysis of this change indicates that it is dependent upon two factors. Either the rate of upward growth of the center of gravity is changing, and it is not keeping pace with the growth of the body, or a residual factor is present which makes the rate of growth of the center appear to slow down even though its actual rate remains the same. Perhaps both of these factors are jointly responsible. The expression of the height of the center of gravity as a ratio, however, will not permit the analysis of this factor, nor will this method give further fundamental information concerning the relationship of the two variables.

Certain measures of correlation which may be employed to establish relationships have been tested in this particular problem. The Pearsonian coefficient, r, was calculated for stature and the height of the center of gravity for a sample group of 200 children between the ages of birth and seven years. In this case r was found to equal +.991 ± 0.003. The interpretation of this high correlation is difficult and indicates to some extent the applicability of measures of correlation to the study. In this case r shows an obvious high degree of concomitance or association which is essentially due to the third factor, time. The actual quantitative relationship between height of the center of gravity and stature is not expressed by the measures of correlation, except, of course, if r be used to derive the least squares' regression line. If this latter use is made of r, essentially the same results will be obtained as by the more direct method to be described later.

The extension of the correlation method to measures of partial correlation does not seem warranted because there are so few cases and because the progression is so steep that even though a small interval is chosen it will not eliminate the time factor.

The application of Harris' ('09) "the correlation between a variable and the deviation of a dependent variable from its probable value" does add, however, another point strictly in the terms of correlation measurement. It is obvious that the height of the center of gravity is dependent upon the height of the body and that the requirements for this coefficient are fulfilled. The calculation of this coefficient between stature and the deviation of the height of the center of gravity from its probable value, upon the sample group of 200 children, gives the value -.28 ± .05. The interpretation of this negative coefficient leads to the same conclusions that are brought out by other methods: that the relative height of the center decreases with the increase in stature. Like the index method, however, it does not permit of a definite

quantitative statement of the deviation.

The third method to be applied to this phase of the problem is essentially a graphic and analytical method that involves the derivation of a mathematical equation to express the relationship between variables.

Figure 5 is a field graph showing the actual distance of the center of gravity from the soles plotted against stature. Similar to Figure 4, this graph extends over the whole of the developmental period from the sixth fetal month to maturity. The graph shows a very striking rectilinear relationship between the two measurements. The variability about the line of progression is notably low and there is certainly no situation along the progression which would indicate more than random deviation from linearity.

This method of attack is carried a step further in Figure 6 (insert in Figure 5) which shows the mean distance of the center of gravity from the soles for each 5 cm. interval of stature plotted against stature. In the analysis males and females have been averaged separately in order that the presence of sex differences may be ascertained. In Tables 12 and 13 are shown the means with their probable errors, standard deviations, and coefficients of variability for the males and females, respectively. In Table 14 the weighted means and measures of variability are shown for both sexes combined. The rectilinearity of relationship between the height of the center of gravity and stature is also clearly shown from the plotted means (Figure 6). A straight line, fitted by means of the method of Concon ('27), and Birge and Shea ('27), shows that the relationship between stature and the height of the center of gravity for both sexes may be expressed by the following formula:

$$y = .557x + 1.4 \text{ cm.}$$

where $\underline{y}$ equals the distance of the center of gravity from the soles and $\underline{x}$ the stature of the body.

This method of analysis furnishes a precise description of the relationship between stature and the distance of the center from the soles. The fact that a straight line gives the best representation of the relationship shows that there is no change in the rate of growth of the center compared with growth in length and that a constant expresses the rate of growth throughout the whole of the developmental period. The small decrease in the index may now be definitely and precisely explained as due to the small residual constant of 1.4 cm. (the $\underline{y}$-intercept of the regression formula).

In order to present this finding in more graphic form a

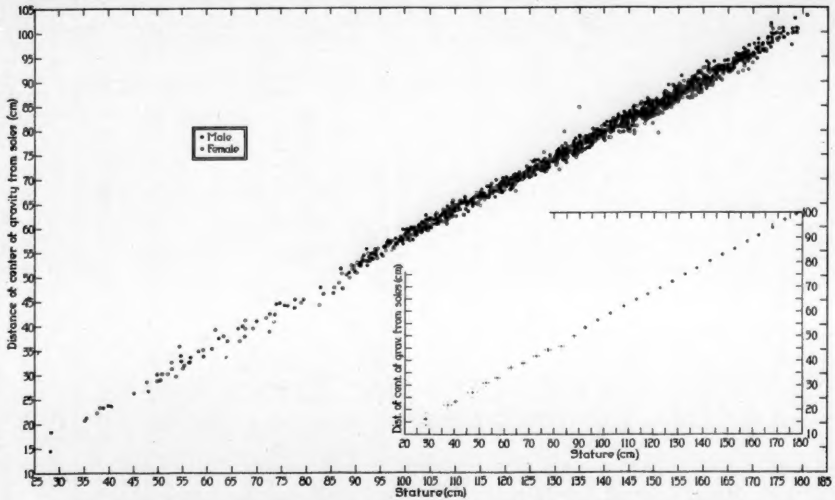

Figure 5. The distance of the center of gravity from the soles plotted against stature, from approximately the sixth fetal month to maturity.

Figure 6 (insert). The relationship between the distance of the center of gravity from the soles and stature. The dots in this graph mark the intersection of the mean height of the center of gravity and the mean stature for each 5 cm. interval of stature. The fine lines above and below each dot represent three times the probable error of the mean height of the center of gravity; the fine lines lateral to each dot represent three times the probable error of the mean stature for the interval.

Table 12

Means and variability, for intervals of stature, of height of transverse plane of gravity from soles (males)

Interval of stature (cm.)	Number of cases	Mean and probable error (cm.)	Standard deviation (cm.)	Coefficient of variability (percent)
25- 30	2	16.5 ± 0.86	0.18	10.91
30- 35	0	- -	-	-
35- 40	1	23.3 ± -	-	-
40- 45	2	23.75 ± 0.06	0.06	2.53
45- 50	2	26.60 ± 0.43	0.90	3.38
50- 55	3	32.23 ± 0.55	1.42	4.41
55- 60	5	33.42 ± 0.30	0.91	2.72
60- 65	3	36.57 ± 0.47	1.21	3.31
65- 70	2	39.70 ± 0.09	0.20	1.40
70- 75	6	42.27 ± 0.60	2.17	5.13
75- 80	5	44.52 ± 0.24	0.80	1.80
80- 85	2	47.05 ± 0.57	1.20	2.55
85- 90	5	49.50 ± 0.74	2.20	4.44
90- 95	15	53.47 ± 0.21	1.20	2.34
95-100	18	56.82 ± 0.15	0.92	1.62
100-105	35	59.62 ± 0.12	1.09	1.83
105-110	27	62.31 ± 0.15	1.16	1.86
110-115	27	64.87 ± 0.15	1.18	1.82
115-120	25	67.45 ± 0.14	0.99	1.47
120-125	26	69.93 ± 0.13	0.95	1.36
125-130	29	72.30 ± 0.17	1.39	1.92
130-135	44	75.37 ± 0.11	1.10	1.46
135-140	47	77.84 ± 0.10	1.04	1.34
140-145	55	80.68 ± 0.11	1.26	1.56
145-150	48	83.54 ± 0.12	1.27	1.52
150-155	39	85.97 ± 0.13	1.18	1.37
155-160	18	89.24 ± 0.22	1.41	1.58
160-165	25	92.16 ± 0.14	1.05	1.13
165-170	45	94.14 ± 0.13	1.30	1.38
170-175	31	97.25 ± 0.18	1.51	1.55
175-180	16	99.67 ± 0.22	1.29	1.29
180-185	1	103.1 ± -	-	-

Table 13

Means and variability, for intervals of stature, of height of transverse plane of gravity from soles

(females)

Interval of stature (cm.)	Number of cases	Mean and probable error (cm.)	Standard deviation (cm.)	Coefficient of variability (percent)
25- 30	0	- -	-	-
30- 35	0	- -	-	-
35- 40	4	22.03 ± 0.40	1.20	5.44
40- 45	0	- -	-	-
45- 50	1	28.70 ± -	-	-
50- 55	8	30.95 ± 0.53	2.23	7.21
55- 60	3	32.83 ± 0.88	2.26	6.88
60- 65	2	38.60 ± 0.40	0.85	2.20
65- 70	5	37.00 ± 0.69	2.28	6.16
70- 75	2	41.25 ± 0.23	0.49	1.88
75- 80	1	44.80 ± -	-	-
80- 85	1	44.10 ±. -	-	-
85- 90	9	50.78 ± 0.37	1.63	3.21
90- 95	16	53.93 ± 0.21	1.25	2.32
95-100	15	56.33 ± 0.18	1.03	1.83
100-105	21	58.97 ± 0.18	1.22	2.06
105-110	31	62.20 ± 0.13	1.08	1.73
110-115	16	65.13 ± 0.11	0.66	1.01
115-120	18	67.02 ± 0.20	1.25	1.86
120-125	30	69.67 ± 0.12	0.94	1.35
125-130	25	72.46 ± 0.13	0.99	1.37
130-135	38	74.94 ± 0.15	1.35	1.80
135-140	30	77.67 ± 0.22	1.75	2.25
140-145	40	80.37 ± 0.14	1.31	1.63
145-150	54	82.78 ± 0.15	1.58	1.91
150-155	60	85.28 ± 0.15	1.76	2.06
155-160	70	88.37 ± 0.10	1.22	1.38
160-165	57	90.47 ± 0.12	1.30	1.43
165-170	18	93.83 ± 0.22	1.36	1.45
170-175	6	97.12 ± 0.81	2.95	3.04
175-180	3	99.20 ± 0.51	1.31	1.32
180-185	-	- -	-	-

Table 14

Means and variability, for intervals of stature, of height of transverse plane of gravity from soles

(both sexes)

Interval of stature (cm.)	Number of cases	Mean and probable error (cm.)	Standard deviation (cm.)	Coefficient of variability (percent)
25- 30	2	16.50 ± 0.86	1.80	10.90
30- 35	0	- -	-	-
35- 40	5	22.28 ± 0.31	1.02	4.58
40- 45	2	23.75 ± 0.03	0.06	0.25
45- 50	3	27.30 ± 0.64	1.64	6.01
50- 55	11	31.30 ± 0.42	2.07	6.61
55- 60	8	33.20 ± 0.31	1.32	3.97
60- 65	5	37.38 ± 0.27	0.90	2.41
65- 70	7	39.20 ± 0.33	1.28	3.27
70- 75	8	42.02 ± 0.43	1.79	4.26
75- 80	6	44.57 ± 0.19	0.70	5.71
80- 85	3	46.00 ± 0.51	1.31	2.85
85- 90	14	50.32 ± 0.29	1.61	3.20
90- 95	31	53.71 ± 0.14	1.17	2.18
95-100	33	56.60 ± 0.11	0.91	1.61
100-105	56	59.38 ± 0.10	1.09	1.84
105-110	58	62.25 ± 0.10	1.10	1.77
110-115	43	64.97 ± 0.10	1.00	1.54
115-120	43	67.27 ± 0.11	1.07	1.59
120-125	56	69.79 ± 0.09	0.95	1.36
125-130	54	72.37 ± 0.11	1.21	1.67
130-135	82	75.17 ± 0.09	1.20	1.60
135-140	77	77.77 ± 0.12	1.49	1.92
140-145	95	80.55 ± 0.09	1.27	1.58
145-150	102	83.14 ± 0.09	1.40	1.68
150-155	99	85.55 ± 0.07	1.02	1.19
155-160	88	88.55 ± 0.09	1.23	1.39
160-165	82	90.99 ± 0.07	0.98	1.08
165-170	63	94.05 ± 0.11	1.23	1.31
170-175	37	97.23 ± 0.19	1.72	1.77
175-180	19	99.60 ± 0.19	1.23	1.24
180-185	1	103.10 -	-	-

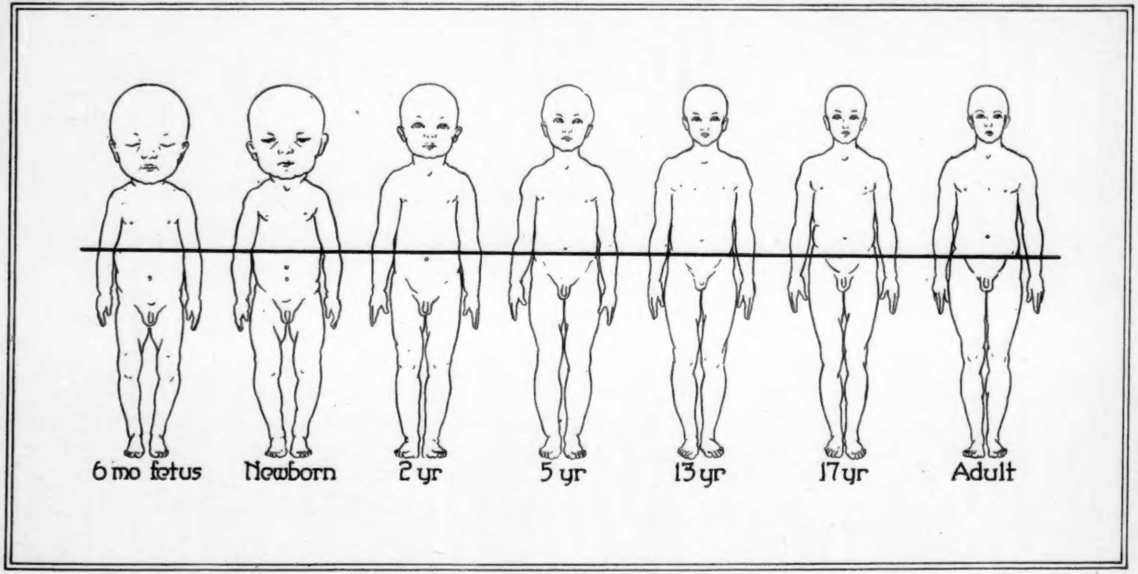

Figure 7. Outline drawings of the ventral aspect of the body at intervals from the sixth fetal month to maturity. Body lengths are reduced to the same scale and the transverse plane of gravity is represented by the transverse line.

series of outline figures illustrating the external form of the body from the sixth fetal month to maturity is shown in Figure 7. In drawing these figures the measurement of stature has been reduced to a common scale and thus a single line may be calculated and drawn through the outlines to show the position of the transverse plane of gravity. The figures illustrate diagrammatically the changes in the form and contour of the body which are largely responsible for the shift of the transverse plane of gravity. The actual anatomic location of this plane and the structures involved in its change of position will be discussed later.

The analytic method readily permits the determination of sex differences. Table 15 shows the differences and probable errors of the differences between the mean heights of the center of gravity at 5 cm. intervals of stature for males and females. The differences and probable errors are illustrated graphically in Figure 8. The solid bar represents the absolute difference between means and the open bar its probable error. The positive side of the histogram indicates that the distance of the center of gravity from the soles for males is greater, and the negative side, that the distance for females is greater. It is shown that at 18 intervals the center is higher in males and at 5 intervals it is higher in females. In only four instances are these differences significant, i.e., three, or more, times the probable error of the difference. The actual meaning of these findings is not definite although it is apparent that for the period during which stature ranges from 145 to 165 cm. the center of gravity is slightly higher in males than it is in females.

The determination of significant differences in this manner introduces the possibility of a difference in the mean stature of the two sexes within a given interval. In Tables 16 and 17 the mean stature for each 5 cm. interval, the probable error of the mean, the standard deviation, and coefficient of variability are given for the males and females, respectively. A comparison of the means for the intervals between 145 and 165 cm., the range over which the sex differences appeared significant, shows that there is no significant difference in the stature of the males and females, except for the interval from 160 to 165 cm. In this interval the mean stature of the males is 162.54 cm. and the mean for the females is 161.83 cm. - a difference of 0.71 cm. The effect of this difference in stature has been determined by means of the analytical equation derived above. After the correction has been made for the differences in stature the difference between the mean height of the center of gravity in the two sexes is found to be 1.29 cm. rather than 1.69 cm. The corrected value is recorded in Table 15 and Figure 8. Despite

Table 15

Significance of sex differences of height of center of gravity as determined by probable errors of means for intervals of stature

Interval of stature (cm.)	Diff. of means $M_{m.} - M_{f.}$ (cm.)	P. E. of diff. (cm.)	Ratio $\frac{\text{Diff.}}{\text{P. E. of diff.}}$
35- 40	+1.27	-	-
40- 45	-	-	-
45- 50	-2.10	-	-
50- 55	+1.28	0.76	1.7
55- 60	+0.59	0.93	0.6
60- 65	-2.03	0.62	3.2
65- 70	+0.70	0.70	1.0
70- 75	+1.02	0.64	1.5
75- 80	-0.28	-	-
80- 85	+2.95	-	-
85- 90	-1.28	0.83	1.5
90- 95	-0.46	0.30	1.5
95-100	+0.49	0.23	2.1
100-105	+0.65	0.22	3.0
105-110	+0.11	0.20	0.6
110-115	-0.26	0.19	1.4
115-120	+0.43	0.24	1.7
120-125	+0.26	0.18	1.3
125-130	-0.16	0.21	0.7
130-135	+0.43	0.19	2.3
135-140	+0.17	0.24	0.7
140-145	+0.31	0.18	1.4
145-150	+0.76	0.19	3.9
150-155	+0.69	0.20	3.4
155-160	+0.87	0.24	3.6
160-165	+1.29	0.18	7.2
165-170	+0.31	0.26	1.2
170-175	+0.13	0.99	0.1
175-180	+0.47	0.56	0.8
180-185	-	-	-

Table 16

Means and variability of stature

(5 cm. intervals)

(males)

Range (cm.)	Number of cases	Mean and probable error (cm.)	Standard deviation (cm.)	Coefficient of variability (percent)
25- 30	2	28.45 ± 0.03	0.06	0.22
30- 35	0	- -	-	-
35- 40	1	39.00 -	-	-
40- 45	2	40.35 ± 0.24	0.49	1.22
45- 50	2	46.70 ± 1.08	2.26	4.84
50- 55	3	53.40 ± 0.98	2.51	4.70
55- 60	6	57.23 ± 0.32	1.15	2.00
60- 65	3	62.53 ± 0.62	1.60	2.57
65- 70	3	67.30 ± 0.24	0.62	0.93
70- 75	6	73.00 ± 0.44	1.61	2.21
75- 80	5	77.44 ± 0.45	1.49	1.92
80- 85	4	83.13 ± 0.42	1.25	1.50
85- 90	5	87.32 ± 0.36	1.20	1.38
90- 95	16	92.04 ± 0.20	1.19	1.30
95-100	18	97.55 ± 0.20	1.28	1.31
100-105	35	102.58 ± 0.16	1.41	1.38
105-110	27	107.78 ± 0.20	1.54	1.43
110-115	27	112.69 ± 0.17	1.28	1.14
115-120	25	157.81 ± 0.19	1.44	0.91
120-125	26	122.41 ± 0.16	1.20	0.98
125-130	29	127.40 ± 0.17	1.36	1.07
130-135	44	132.28 ± 0.15	1.50	1.14
135-140	46	137.26 ± 0.13	1.29	0.94
140-145	55	142.44 ± 0.14	1.57	1.10
145-150	48	147.49 ± 0.14	1.43	0.97
150-155	40	152.56 ± 0.15	1.36	0.89
155-160	18	157.63 ± 0.24	1.48	0.94
160-165	25	162.54 ± 0.18	1.32	0.81
165-170	45	167.75 ± 0.16	1.53	0.91
170-175	31	172.42 ± 0.16	1.32	0.76
175-180	16	177.51 ± 0.24	1.42	0.80
180-185	1	181.60 ± -	-	-

Table 17

Means and variability of stature

(5 cm. intervals)

(females)

Range (cm.)	Number of cases	Mean and probable error (cm.)	Standard deviation (cm.)	Coefficient of variability (percent)
35- 40	4	36.70 ± 0.51	1.54	4.20
40- 45	0	- -	-	-
45- 50	1	48.00 -	-	-
50- 55	8	52.28 ± 0.39	1.63	3.12
55- 60	3	56.50 ± 0.88	2.26	4.00
60- 65	2	62.55 ± 0.51	1.06	1.69
65- 70	5	67.82 ± 0.25	0.83	1.22
70- 75	2	72.75 ± 0.51	1.06	1.46
75- 80	1	77.70 -	-	-
80- 85	1	81.60 -	-	-
85- 90	11	88.19 ± 0.30	1.48	1.68
90- 95	16	92.94 ± 0.26	1.51	1.62
95-100	15	97.84 ± 0.19	1.09	1.11
100-105	21	102.45 ± 0.25	1.69	1.65
105-110	31	107.94 ± 0.18	1.48	1.37
110-115	16	112.79 ± 0.31	1.85	1.64
115-120	18	116.91 ± 0.25	1.58	1.35
120-125	30	122.22 ± 0.15	1.24	1.02
125-130	25	127.61 ± 0.19	1.43	1.12
130-135	38	132.51 ± 0.15	1.33	1.00
135-140	30	137.20 ± 0.17	1.40	1.02
140-145	40	142.50 ± 0.17	1.58	1.11
145-150	54	147.88 ± 0.15	1.61	1.09
150-155	60	152.74 ± 0.13	1.44	0.94
155-160	70	157.50 ± 0.11	1.36	0.86
160-165	57	161.84 ± 0.12	1.40	0.86
165-170	18	167.73 ± 0.27	1.68	1.00
170-175	6	172.45 ± 0.50	1.82	1.05
175-180	3	175.80 ± 0.18	0.46	0.26

the correction, however, the difference between the sexes in this interval remains seven times its probable error.

Three methods of attacking the problem of the relationship between stature and the height of the center of gravity have been discussed. The first of these was the expression of the relation by means of an index. The second method involved the calculation of various measurements of correlation. In the third, an analytical geometric expression was obtained to show the relationship. The relative merits of these methods are important.

The use of the index method is largely responsible for many erroneous conceptions. The materials of Croskey, Dawson, Leussen, Marohn and Wright show essentially the same facts that have been brought out in the present study. The use of the

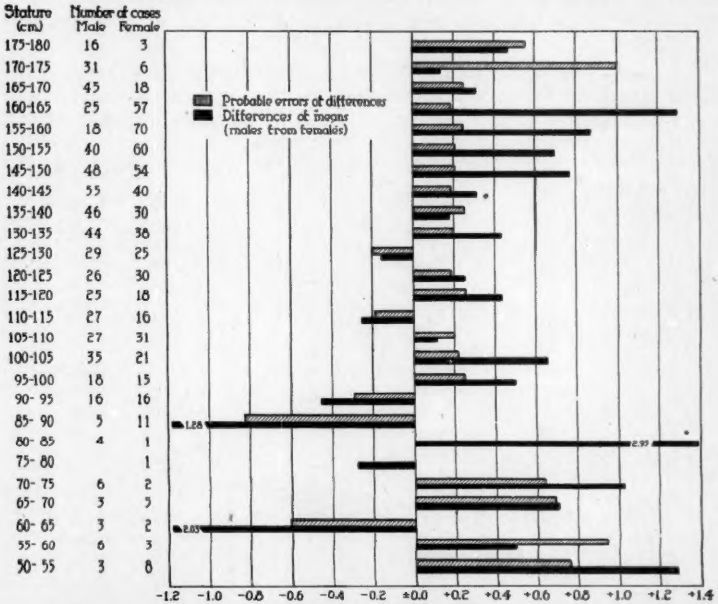

Figure 8. The significance of sex differences of the distance of the center of gravity from the soles, as determined by the differences and probable errors of the means for intervals of stature. The positive side of the scale shows that the distance for males is greater and the negative side that the distance for females is greater.

index, however, so misled these investigators that they definitely stated, "there was no acceptable correlation found between either height or weight and the center of gravity." Their correlations were, of course, made between the relative height of the center of gravity and body length and are questionable from the standpoint of both accuracy and interpretation. In addition, their use of the index not only completely obscured the fundamental relation between stature and the position of the center of gravity, but led them to make an entirely erroneous presentation.

The results of this and previous investigations indicate that the index or per cent method does not furnish the most satisfactory means of handling this material. In this instance the relationship between the height of the center of gravity and stature is quite accurately expressed by the index, but still more precise relationships are obtained by the use of the analytic method.

Further study of the distance of the center of gravity from the soles in respect to other factors has been made.

Figure 9 is a field graph showing both the distance of the

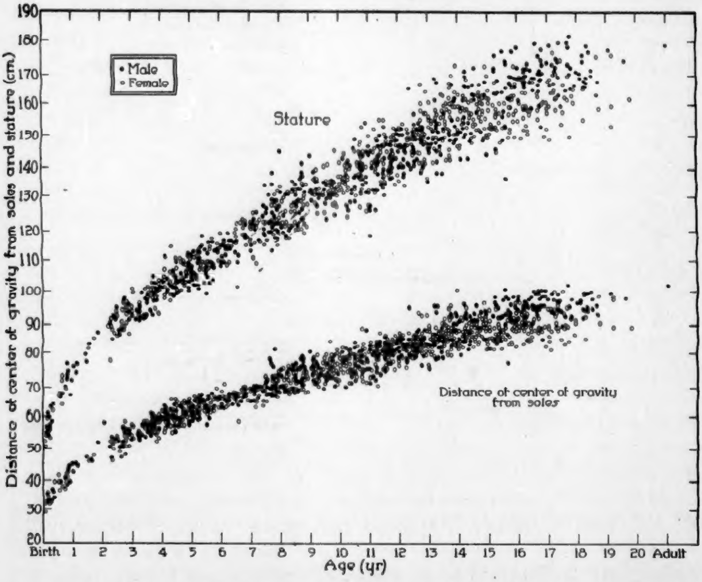

Figure 9. Both stature and the distance of the center of gravity from the soles plotted against age, from birth to maturity.

center above the soles and stature plotted against age. The upper progression follows a curve typical of the postnatal growth of the body in length. The lower progression follows a similar curve showing the growth of the center of gravity in height. Both curves are of the same general type and reflect the very close relationship existent between the two measurements. The variability of stature about its line of progression is representative of the age-length distribution. The variability of the height of the center of gravity about its line of progression is distinctly less than that for stature. Part of this reduction in variability may be explained by the fact that there is less experimental error inherent in determining the position of the transverse plane of gravity than in determining stature. This factor does not account for all of the difference in variability and it is clearly shown that the height of the center of gravity is a very stable measure of the growth of the body. During the first two years of postnatal life the rate of increase in the distance of the center of gravity from the soles is rapid. The rate then gradually decreases and proceeds in a very regular manner during the remainder of the postnatal growth period.

The height of the center of gravity above the soles is plotted against the weight of the body in Figure 10. The curvilinear progression shown in this figure is typical of the relationship between height and weight and again there is a reflection of the close relation between the position of the center of gravity and stature. It is shown, also, that the association between the center of gravity and body weight is not so precise as that between the center of gravity and body length.

A study has been made of the relations of the transverse plane of gravity with respect to other anatomic landmarks. In Figure 11 the trochanter-planta distance is plotted against stature. This is essentially leg length compared with body length, and it is seen that there is a simple rectilinear relationship between the two dimensions. The relationship is very similar to that of the height of the center of gravity and stature, and the question arises whether the height of the center of gravity and the lower extremities grows in the same manner and at the same rate. To ascertain this point, the fitted regression line of the height of the center of gravity upon stature has been drawn upon the field graph of leg length and stature. The slope of the calculated regression line compared with the progression of leg length, shows that the lower extremities are growing at a greater rate than the center of gravity is moving. This more rapid rate of growth of the lower extremities gradually brings the center of gravity closer to the proximal end of the lower limbs. An estimate of the actual changes shows that at birth

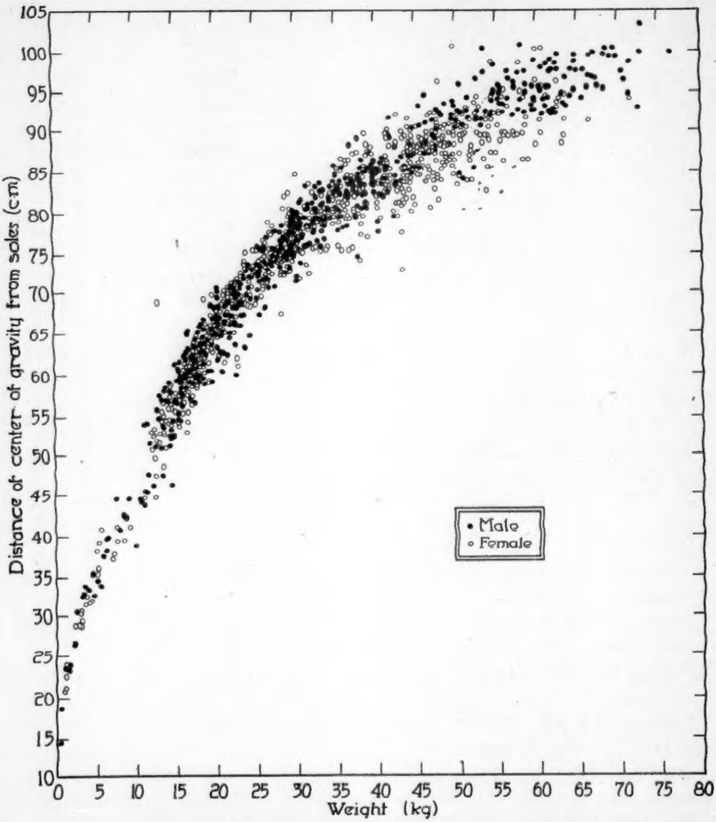

Figure 10. The distance of the center of gravity from the soles plotted against body weight, from approximately the sixth fetal month to maturity.

the center of gravity lies approximately 20 cm. above the trochanters and at maturity this distance has been reduced to 10 cm. A distance of 20 cm. above the trochanters in the newborn body brings the center of gravity into a position relatively high above the legs, approximately to the lower level of the thoracic cavity. A distance of 10 cm. above the trochanters in the adult body brings the center into a position relatively close to the lower extremity, actually, to the approximate level of the

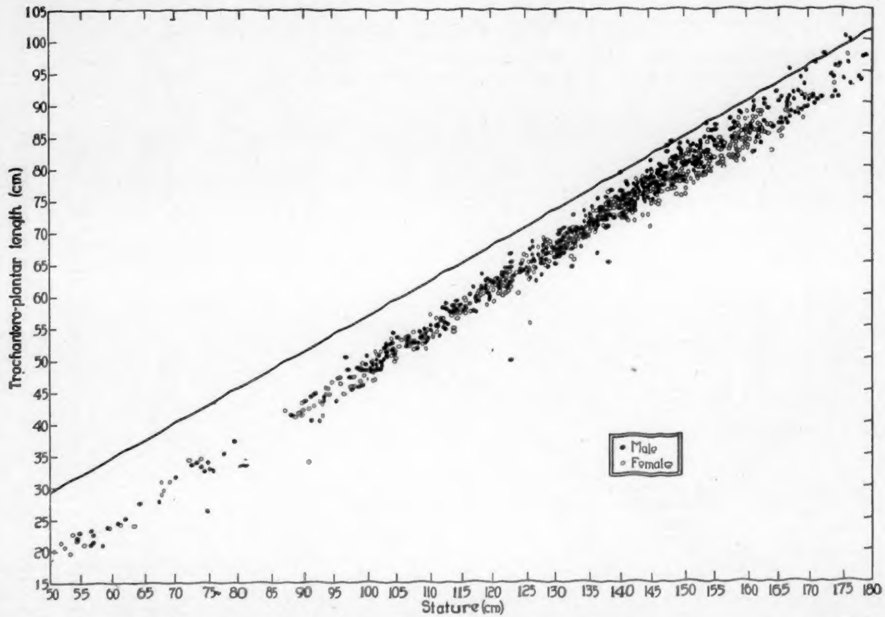

Figure 11. The trochanter-planta length plotted against stature, from birth to maturity. The straight line is the regression line calculated for the distance of the center of gravity from the soles and stature.

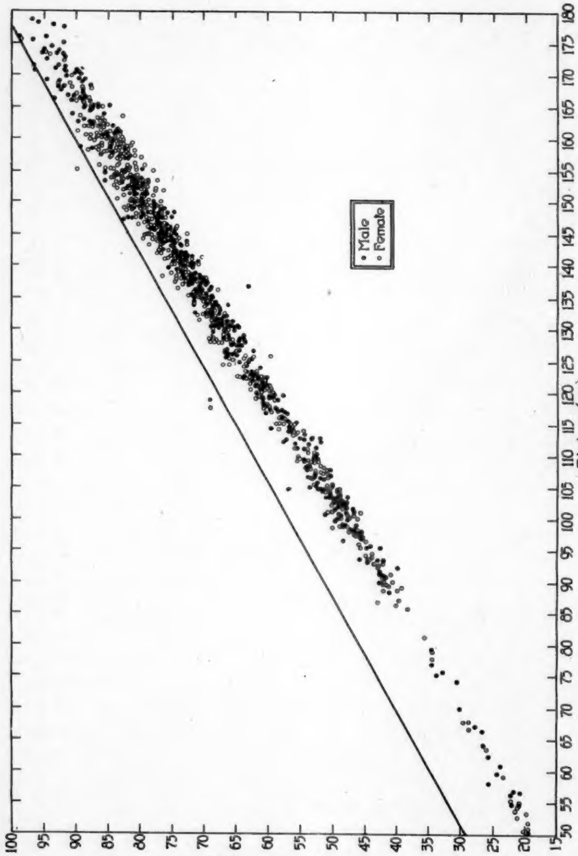

Figure 12. The pubis-planta distance plotted against stature, from birth to maturity. The straight line represents the regression line calculated for the distance of the center of gravity from the soles and stature.

iliac crests. This finding is in accord with the measurements of Meyer who found the center of gravity to lie 9.5 cm. above the point of rotation of the heads of the femora.

These changes in the position of the center of gravity are of interest from the point of view of the mechanics of motor activity. Any movement of the body, and in particular, any movement of locomotion, involves changing the position of the center of gravity in space. From a mechanical standpoint it is well known that the efficiency of energy expended to produce motion is dependent upon the location of the center of mass of the object moved. Greater efficiency is obtained by approximating the center of mass and the moving power. In the human body the assumption of the erect posture has placed the problem of locomotion largely upon the lower extremities. From this point of view, efficiency in locomotion is slowly increased during the developmental period as the center of gravity descends from a position high above the lower extremities to a position in close proximity to the chief motive power in the legs.

The stability of the human body is intimately connected with this problem. The stability of any body is inversely related to the distance of its center of mass from the basis of support. It has been shown, particularly in Figure 5, that the absolute distance of the center of gravity above the soles, or basis of support, increases; therefore, the stability of the body decreases during growth. It has been shown, as well, that the relative height of the center of gravity slightly decreases, which tends to compensate to a very slight extent for the increased distance from the base. From this point of view the adult human body is much more unstable than the infant body. It seems justifiable to believe, however, that the increased mechanical efficiency brought about by the closer proximity of the center of mass and its activating force must compensate for the greater instability. Many factors and forces are involved in such general problems as locomotion, equilibrium and mechanical efficiency, but it is not possible to go into these problems except to indicate further applications of this study.

An investigation similar to that made of the trochanter-planta length has been made for the pubis-planta length. In Figure 12 the pubis-planta length is plotted against stature and the calculated regression line of the height of the center of gravity against stature drawn upon the field graph. Almost the same changes seen in Figure 11 indicate that the trochanter-planta and pubis-planta lengths are practically identical. The transverse plane of gravity in the newborn passes through the trunk approximately 20 cm. above the upper margin of the pubis. During the

remainder of the developmental period this plane descends through the abdomen until it is 10 cm. above the pubis. Although this shift of the plane of gravity appears small, only 10 cm., a marked change is made in the actual anatomic location of the plane. Twenty centimeters above the symphysis in the trunk of the newborn reaches almost to the tip of the xiphoid process, while 10 cm. above the symphysis in the trunk of the adult marks a point relatively close to the upper margin of the pubis itself. Details of the anatomic structures through which this plane moves will be discussed later.

The distance of the transverse plane of gravity from the crown or vertex was calculated by subtracting the distance of the transverse plane above the soles from stature. The relation between this measurement and stature can be analytically expressed by the equation:

$$z = .443x - 1.4 \text{ cm.}$$

where $\underline{z}$ equals the distance from the center to the crown and $\underline{x}$ equals stature. This formula was derived by transforming the equation expressing the relationship between the distance of the center of gravity from the soles and stature.

In order to determine the relationship between the lineal growth of the trunk and the position of the transverse plane, the distance of the transverse plane from the crown was plotted against sitting height. Figure 13 is a field graph of this material. It is shown that the simple rectilinear relationship found between the transverse plane and stature does not hold in this case. This progression forms a very shallow "s" curve, which is probably due to the extremely slow growth of the head during postnatal life. In connection with this point, stature has been plotted against sitting height as shown in Figure 14. The same shallow "s" curve which results provides further evidence that the divergence from linearity seen in the previous curve is not due to any change of the fundamental relationship between the height of the center of gravity and stature.

The Position of Frontal Plane of Gravity

Observations upon the distance of the center of gravity from the back present a complex problem. These measurements are shown plotted against stature in Figure 15. The first portion of the curve shows a wide distribution in which there appears a very curious trend. But after stature reaches 90 cm. the variability is markedly decreased and a simple upward trend appears. A more detailed analysis of this material was

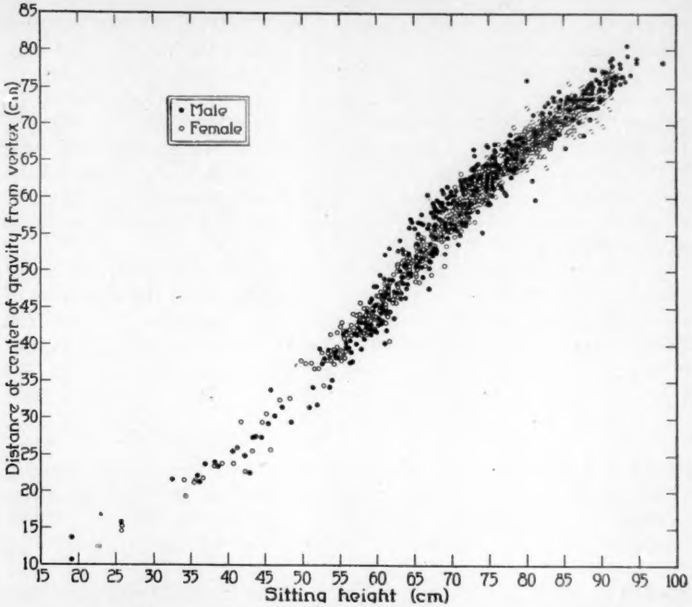

Figure 13. The distance of the center of gravity from the crown plotted against sitting height, from approximately the sixth fetal month to maturity.

made by calculating the means of the distance of the center of gravity from the back for each 10 cm. interval of stature. The sexes have been separated in this analysis and Tables 18, 19, and 20 show the means with their probable errors, standard deviations and coefficients of variability for the males, females, and for the sexes combined, respectively. The means for the sexes combined, together with their probable errors, are plotted against stature in Figure 16. The trends which were not distinctive in the field graph are definitely brought out in this figure. It is demonstrated that this dimension is rapidly increasing toward the close of fetal life and that the rate of increase is maintained until the middle of the first year of postnatal life. At this time it stops its rapid growth abruptly and the absolute values decrease until nearly the end of the second year. Very late in the second year it again begins to increase, maintaining a low rate of growth to maturity. No attempt has been made to fit this curious curve and no

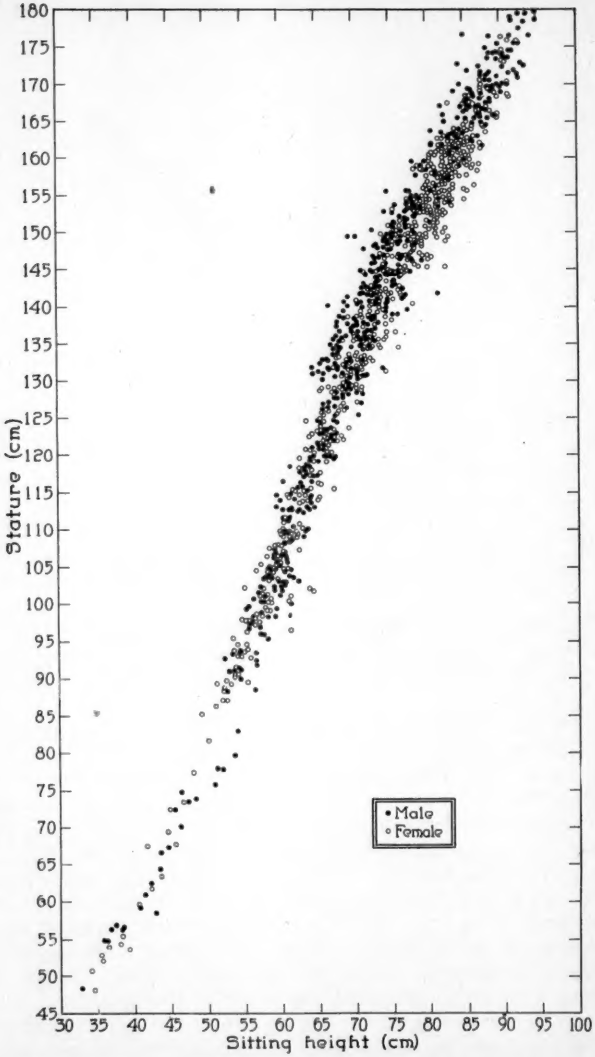

Figure 14. Stature plotted against sitting height, from approximately the sixth fetal month to maturity.

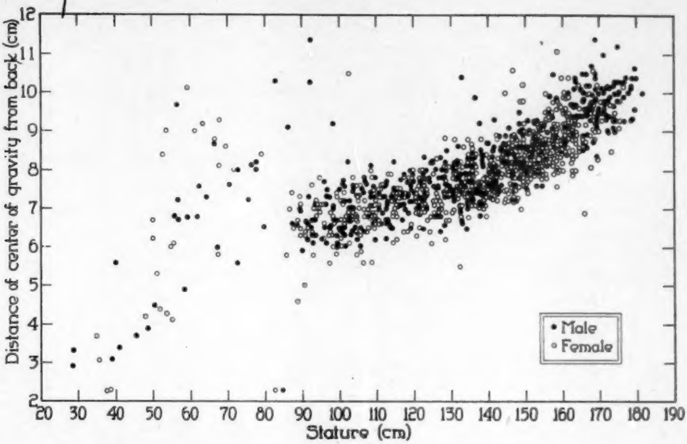

Figure 15. The distance of the center of gravity from the back plotted against stature, from approximately the sixth fetal month to maturity.

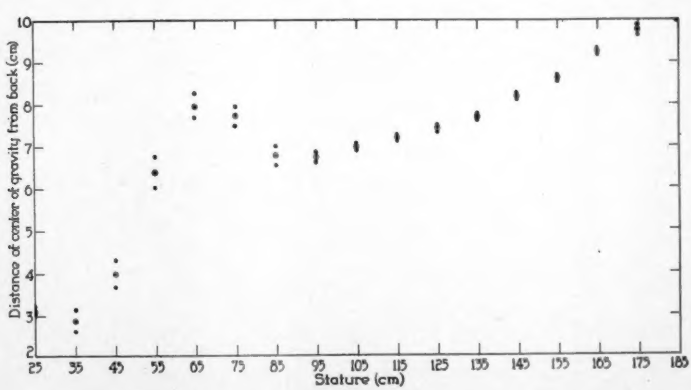

Figure 16. The mean distances of the center of gravity from the back, for 10 cm. intervals of stature, plotted against stature. The encircled dots represent the means and the smaller dots the probable errors of the means.

Table 18
Means and variability for intervals of stature of distance of frontal plane of gravity from back
(males)

Interval of stature (cm.)	Number of cases	Mean and probable error (cm.)	Standard deviation (cm.)	Coefficient of variability (percent)
20- 30	2	3.10 ± 0.10	0.20	6.45
40- 50	5	3.94 ± 0.29	0.96	24.44
50- 60	6	6.32 ± 0.36	1.31	20.74
60- 70	5	7.28 ± 0.30	1.00	13.74
70- 80	8	7.40 ± 0.22	0.92	12.48
80- 90	5	7.26 ± 0.29	0.96	13.16
90-100	31	6.86 ± 0.11	0.90	13.11
100-110	62	7.00 ± 0.05	0.53	7.50
110-120	52	7.20 ± 0.04	0.43	5.93
120-130	54	7.50 ± 0.05	0.49	6.49
130-140	91	7.76 ± 0.04	0.60	7.76
140-150	103	8.15 ± 0.03	0.49	5.95
150-160	57	8.64 ± 0.05	0.57	6.62
160-170	70	9.52 ± 0.05	0.61	6.37
170-180	46	9.82 ± 0.05	0.54	5.53
180-190	1	10.00 ± -	-	-

Table 19
Means and variability for intervals of stature of distance of frontal plane of gravity from back
(females)

Interval of stature (cm.)	Number of cases	Mean and probable error (cm.)	Standard deviation (cm.)	Coefficient of variability (percent)
20- 30	-	- -	-	-
30- 40	4	2.85 ± 0.23	0.68	23.86
40- 50	1	4.20 ± -	-	-
50- 60	11	6.43 ± 0.40	1.98	30.79
60- 70	7	8.40 ± 0.31	1.21	14.40
70- 80	3	8.63 ± 0.23	0.60	6.95
80- 90	10	6.55 ± 0.17	0.82	12.44
90-100	32	6.58 ± 0.08	0.69	10.46
100-110	51	6.91 ± 0.07	0.71	10.33
110-120	34	7.18 ± 0.06	0.52	7.21
120-130	55	7.31 ± 0.05	0.54	7.43
130-140	67	7.63 ± 0.05	0.57	7.50
140-150	94	8.15 ± 0.05	0.69	8.41
150-160	130	8.59 ± 0.03	0.58	6.78
160-170	75	9.00 ± 0.05	0.63	7.00
170-180	9	9.47 ± 0.16	0.72	7.65
180-190	-	- -	-	-

Table 20

Means and variability for intervals of stature of distance of frontal plane of gravity from back (both sexes)

Interval of stature (cm.)	Number of cases	Mean and probable error (cm.)	Standard deviation (cm.)	Coefficient of variability (percent)
20- 30	2	3.10 ± 0.10	0.20	6.45
30- 40	4	2.85 ± 0.23	0.68	23.86
40- 50	6	3.98 ± 0.24	0.88	22.11
50- 60	17	6.39 ± 0.29	1.74	27.23
60- 70	12	7.93 ± 0.18	0.90	11.34
70- 80	11	7.74 ± 0.13	0.62	8.01
80- 90	15	6.78 ± 0.14	0.78	11.50
90-100	63	6.72 ± 0.08	0.79	11.75
100-110	113	6.96 ± 0.04	0.61	8.76
110-120	86	7.19 ± 0.03	0.46	6.40
120-130	109	7.40 ± 0.03	0.51	6.89
130-140	158	7.70 ± 0.03	0.59	7.66
140-150	197	8.15 ± 0.02	0.59	7.24
150-160	187	8.61 ± 0.02	0.57	6.62
160-170	145	9.25 ± 0.02	0.47	5.08
170-180	55	9.76 ± 0.04	0.50	5.12
180-190	1	10.00 -	-	-

Table 21

Significance of sex differences of height of center of gravity as determined by probable errors of means for intervals of stature

Interval of stature (cm.)	Diff. of means $M_{m.} - M_{f.}$ (cm.)	P. E. of diff. (cm.)	Ratio $\frac{\text{Diff.}}{\text{P. E. of diff.}}$
50- 60	-0.11	0.50	0.22
60- 70	-0.12	0.43	2.60
70- 80	-1.23	0.32	3.84
80- 90	+0.71	0.34	2.09
90-100	+0.28	0.14	2.00
100-110	+0.09	0.09	1.00
110-120	+0.02	0.07	0.30
120-130	+0.19	0.07	2.71
130-140	+0.13	0.06	2.17
140-150	0.00	0.06	0.00
150-160	+0.05	0.06	0.83
160-170	+0.52	0.07	7.43
170-180	+0.35	0.17	2.06
180-190	-	-	-

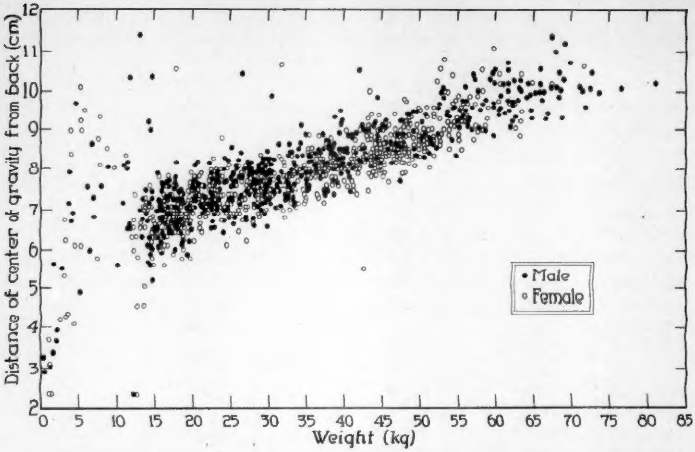

Figure 17. The distance of the center of gravity from the back plotted against body weight, from approximately the sixth fetal month to maturity.

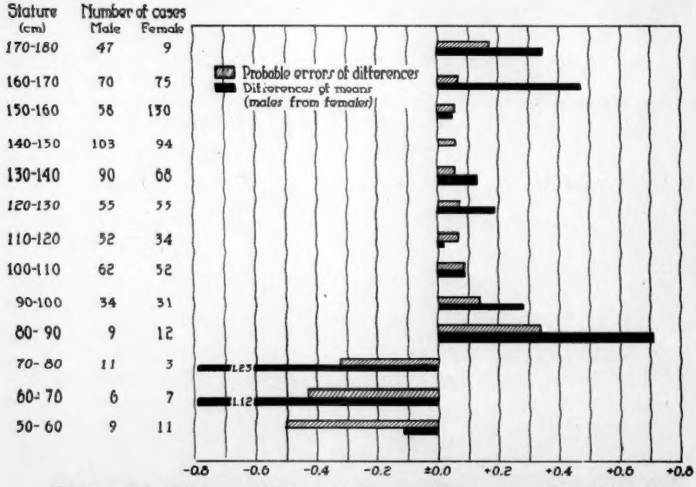

Figure 18. The significance of sex differences of the distance of the center of gravity from the back, as determined by the differences and probable errors of the means for intervals of stature. The positive side of the scale shows that the distance for males is greater and the negative side that the distance for females is greater.

satisfactory explanation can be offered for it. Figure 17, a field graph of this measurement plotted against body weight, shows a similar trend indicating that essentially the same relationship is maintained for both height and weight.

The result of a study of sex differences in the frontal plane of gravity is shown in Table 21 and Figure 18. The table shows the differences and probable errors of the differences of the mean distance of the center of gravity from the back for 10 cm. intervals of stature. The same facts are graphically illustrated in the figure. Significant differences are not definitely brought out, but the same general facts are indicated as were found for the transverse plane. It is probable that the center of gravity is slightly further from the back in males than in females, for the period during which stature ranges from 150 cm. to 170 cm. The effects of slight differences in stature within 10 cm. intervals are not considered significant in this analysis.

The dimensions of the trunk at the level of the transverse plane of gravity are not available. However, measurements of the transverse and anteroposterior diameters of the chest and pelvis have been made, and, although they do not represent the precise section of the body involved, it is desirable to make certain comparisons. In Figure 19 the anteroposterior diameter at the apex of the costal angle is plotted against stature and in Figure 20 the sacro-pubic, or external conjugate, diameter is plotted against stature. Upon both of these field graphs the mean distances of the frontal plane of gravity for intervals of stature are shown. Both of these diametral measurements follow simple regular progressions and give no clue to the definite inflections seen in the curve representing the distance of the center of gravity from the back.

The Anatomic Position of Center of Gravity

Griffith has shown that when the fetal body is placed in the normal intrauterine position its center of gravity lies approximately at the "site of entrance of the vena cava into the heart." Solis, working with two full term newborn bodies, determined the center of gravity in both the intrauterine and supine positions. In the former position Solis found that the transverse plane crossed the body 0.5 cm. below the tip of the xiphoid, ventrally, and between the spines of the eighth and ninth thoracic vertebrae, dorsally. In the supine position this plane shifted from 2 to 2.5 cm. caudally where it crossed the body dorsally at the tip of the tenth thoracic spine. In the latter position the center was found to lie 3.7 cm. from the dorsimesal surface of the body. A somewhat similar investigation was made upon two

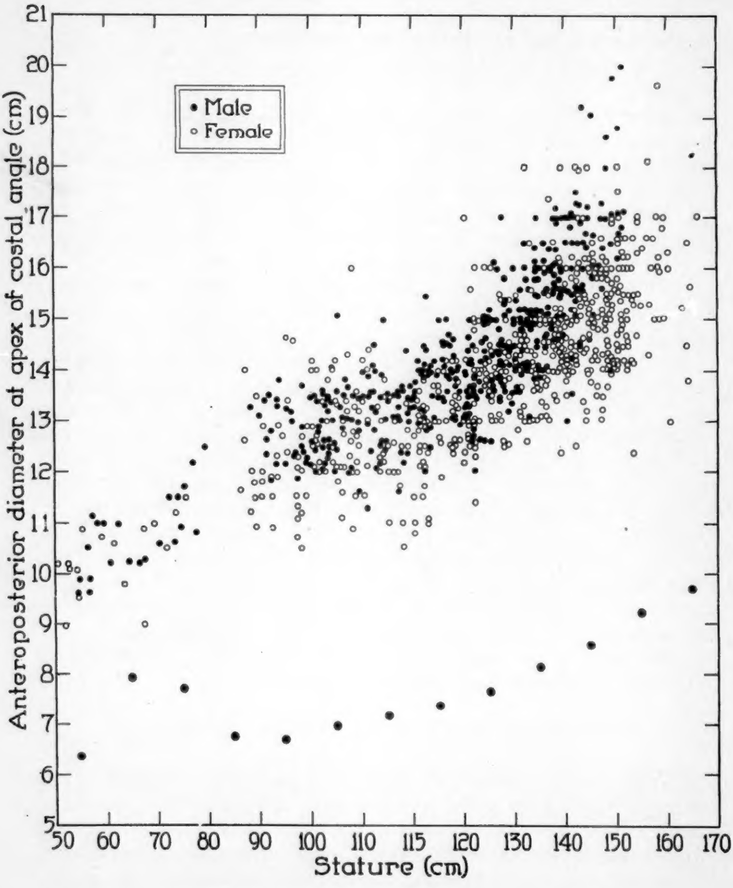

Figure 19. The anteroposterior diameter of the chest at the apex of the costal angle plotted against stature. The large encircled dots in the lower part of the field represent the mean distance of the center of gravity from the back for the same intervals of stature.

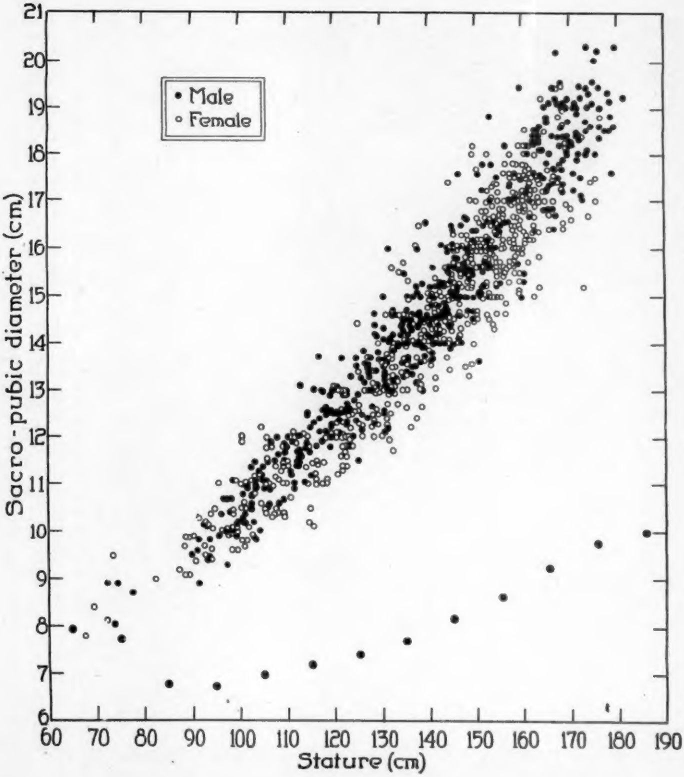

Figure 20. The anteroposterior diameter of the pelvis (sacro-pubic diameter) plotted against stature. The large encircled dots in the lower part of the field represent the mean distances of the center of gravity from the back for the same intervals of stature.

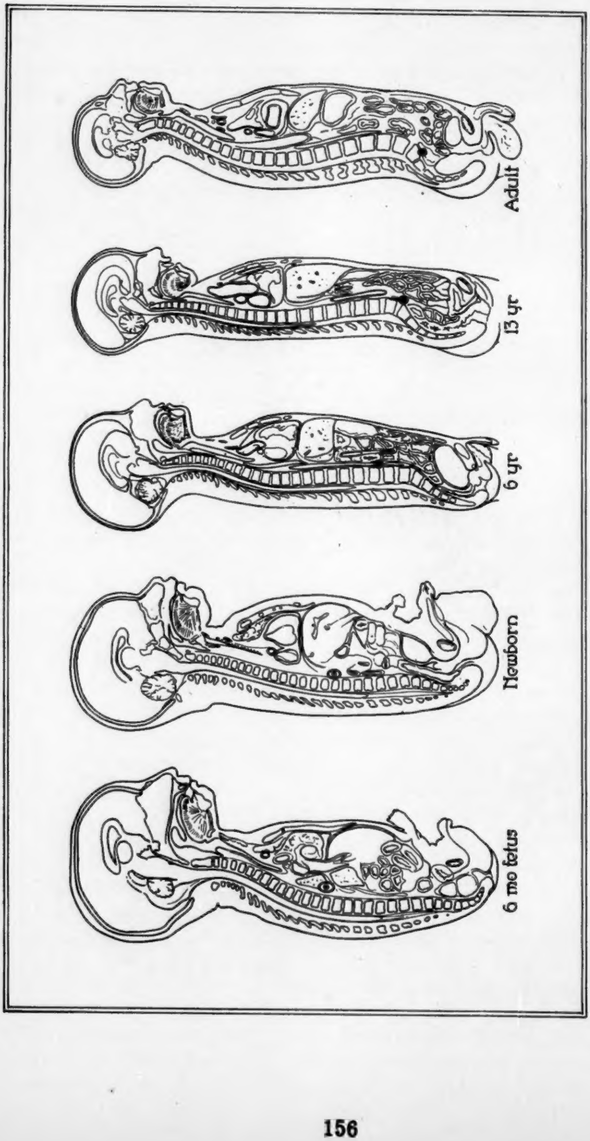

Figure 21. Five midsagittal drawings of the body at intervals from the sixth fetal month to maturity. The large solid dot indicates the mean position of the center of gravity. The ellipse drawn around each dot represents the "probable area" of the center of gravity as determined by three times the probable errors of the mean position of the center of gravity.

full term newborns in the present study. Orientation measurements and center of gravity determinations were made with the body in the supine position. Subsequent dissections and measurements of these specimens were made to locate anatomically the actual center of gravity. In both instances the center was found to lie just anterior to the intervertebral disc between the tenth and eleventh thoracic vertebrae in the immediate vicinity of the anterior margin of the aortic hiatus in the diaphragm. In one specimen the distance from the center of gravity to the posterior surface of the body was 3.7 cm., in the other it was 4.4 cm. The bodies used for this work are indicated in Table 11, where a detailed record of their dimensions is given.

Observations upon the actual location of the center of gravity at other times during the growth period are not found in the literature except for the few measurements upon adults made by Meyer, and Braune and Fischer. Meyer estimated by means of his approximation method that the center of gravity in the adult lies in the canal of the second sacral vertebra. Braune and Fischer's examination of the body showed that the actual center was located either within or just in front of the second or third sacral vertebra.

The material now available permits an extension of the phase of the problem concerned with the anatomic location of the center of gravity, Figure 21.

A series of drawings of the midsagittal plane of the body was obtained. The drawings selected were chosen because they represent either actual size or scale figures that accurately picture structures and relations. The series consists of 5 figures; a 6 months old fetus, a newborn child, a child of 6 years, a child of 13 years, and a mature adult. The midsagittal views of the 6 and 13 year old children were obtained from the actual size drawings of Symington ('87). The fetus and newborn figures were taken from Merkel ('94), and the adult figure, after Merkel, from Braune.

Sufficient data were furnished with each figure to make possible a fairly accurate estimation of the actual position of the center of gravity. The location of the center was determined upon the basis of the analytical equation derived above and upon the mean distances given in Tables 14 and 20. The calculated values were reduced to the proper scale and the measured position of the center was marked directly upon the original plates. In addition to the center of gravity, the variability of the center was shown in the following manner. The probable error of the array (0.6745 times standard deviation) for each mean in both the transverse and frontal planes was

determined from Tables 14 and 20. The positive and negative values of these probable errors were then marked on both the transverse and horizontal planes and the four points obtained were joined by means of a smooth curve. The range of one probable error about each center of gravity was thus indicated by an elliptical area. This 'probable area' takes the form of an ellipse because of the differences in variability of the two planes of gravity. The long axis of the ellipse is vertical, which pictorially demonstrates that the variability of the transverse plane of gravity is greater than the variability of the frontal plane. These figures were photographed directly from the original plates and accurate scale drawings subsequently made from the negative films by means of a photographic enlarging and reducing apparatus. Figure 21 shows this series of figures all drawn to the same crown-rump length.

This graphic method of presentation not only shows the actual anatomic location of the center of gravity but also gives a clear demonstration of the variability of the center of gravity and of the accuracy with which the present method may be applied to the study of living individuals. It is shown from the figures that the center of gravity at the sixth fetal month (body placed in the supine position) lies ventral to the body of the seventh dorsal vertebra in the lower part of the thoracic cavity above the diaphragm. In the newborn infant the center has shifted slightly and lies along the ventral border of the aorta where that vessel passes through the diaphragm and at this time is at the level of the intervertebral disc between the tenth and eleventh thoracic vertebrae. By the sixth year of postnatal life it has descended through the abdominal cavity to the lower level of the third lumbar vertebra, and probably lies within the aorta. During the thirteenth year it is situated just ventral to the promontory of the sacrum. In the adult body the center has definitely dropped into the pelvis and is located practically upon the ventral surface of the first segment of the sacrum.

It is thus shown that the center of gravity occupies a position above the dome of the abdominal cavity during the later months of prenatal life. During the remainder of the growth period it slowly descends through the full length of the abdominal cavity to finally take a position just over the brim of the pelvis in the adult body. During the whole of this time the center appears to lie fairly close to the ventral border of the vertebral column. In very general descriptive terms, it may be said that the center of gravity in the newborn is situated at the origin of the abdominal division of the aorta and that during growth it descends through the bifurcation of the aorta, to a

position just over the brim of the pelvis.

The descent of the center of gravity during growth furnishes another striking example of the "law of developmental direction." Changes in the center of mass reflect the complex results of the growth of all parts of the body and indicate that the growth of the body as a whole follows the same general law which governs the growth of nearly all its parts.

GENERAL SUMMARY

The available published data on the position of the center of gravity in the human body and on methods for locating the center have been briefly reviewed.

A method and apparatus have been developed for determining two planes, the transverse and frontal, which pass through the center of gravity in the living human body. The method is applicable to individuals of all ages, it requires very little cooperation of the subject, and permits the complete execution of a determination in less than five minutes.

The precision of the method and apparatus has been tested experimentally upon inert objects and living individuals. It was found that the center of gravity can be located within a circle of 0.75 mm. in diameter in inert objects, and can be located in the living human body with the same precision that standing height and sitting height can be measured.

A quantitative analysis of the position of the center of gravity has been based upon the study of 1200 individuals whose ages range from 6 fetal months to 20 years. The following data were secured upon nearly every living individual: name, sex, age, weight, body length, stature, sitting height, pubic height, arm length, leg length, the transverse and antero-posterior diameters of the head, chest, and pelvis, and the distance of the center of gravity from the soles and from the back.

The distance of the center of gravity above the soles, expressed as an index or per cent of stature, maintained a fairly constant ratio, which ranged from 55.0 to 59.0, during the whole of the developmental period. The coefficient of correlation, r, between the distance of the center of gravity above the soles and stature was of the order of .99. The most precise statement of the relationship between this distance and stature was expressed by the analytical equation:

$$y = 0.557x + 1.4 \text{ cm.}$$

where y equals the distance of the center from the soles, and x equals stature. The relationship was definitely rectilinear and the variability around the regression line was low.

The close association of the position of the transverse plane of gravity and stature was reflected in the other relationships studied; these included age, weight, sitting height, leg length, and pubic height. In this connection, the center of gravity was found to lie 20 cm. above the trochanter in the newborn body and 10 cm. above the trochanter in the adult body.

The distance of the frontal plane of gravity from the back showed a rapid increase during the latter part of fetal life. This increase continued until a temporary maximum of approximately 8 cm. was reached at about the middle of the first year. The period following, during which stature increased from 65 cm. to 95 cm., was marked by the shortening of the distance to slightly less than 7 cm. The distance of the center of gravity from the back showed a slow, regular, increase during the remaining portion of the growth period. The same general trend was observed in the relation between the distance of the center of gravity from the back and body weight. No explanation can be offered for the inflections of these curves.

The grouping of the data according to sex permitted a statistical analysis which showed that the center of gravity was very slightly, but significantly, higher and further from the back in males than in females during the approximate period in which stature increased from 145 cm. to 165 cm.

Changes in the anatomic position of the center of gravity have been shown by means of a series of midsagittal figures upon which the probable area' of the centers have been drawn. The descent of the center from the level of the seventh dorsal verbrate to the level of the first sacral vertebra was illustrated and described.

BIBLIOGRAPHY

Bardleben, F. V. Statik und Mechanik des menschlichen Körpers. Leipzig, 1909.

Barnum, C. The effect of gravity on the presentation and position of the fetus. J. Am. Med. Assoc., 1915, 64, 498-502.

Birge, R. T. and Shea, J. D. A rapid method for calculating the least square solution of a polynomial of any degree. Univ. of California Publ. in Math., 1927, 2, 67-118.

Borelli, G. A. De Motu Animalium. Luduni Bat. (Quoted from D. le Clerc and J. J. Mangetus, Bibliotheca Anatomica, Pars Secunda, de Thorace, 1680, 873.)

Boyd, E. The experimental error inherent in measuring the growing human body. Am. J. Phys. Anthrop., 1929.

Braune, W. und Fischer, O. Über dem Schwerpunkt des

menschlichen Körpers mit Rücksickt auf die Ausrüstung des deutschen Infanteristen. Abhandl. d. mathem. -nature, Klasse d. Kgl. Sächs. Akad. Wiss., 1889, 15, VII, 631. (Cited by Scheidt, '22.)

_____ Kgl. Sächs. Ges. Wiss. Leipz. math. physik. Kl., 1890, 561. (Cited from Croskey, Dawson, Luessen, Marohn, and Wright, '22.)

Condon, E. The rapid fitting of a certain class of empirical formulae by the method of least squares. Univ. of California Publ. in Math., 1927, 2, 55-66.

Croskey, M., Dawson, P., Luessen, A., Marohn, I., and Wright, H. The height of the center of gravity in man. Am. J. Physiol., 1922, 61, 171-185.

Demeny, G. Etude des déplacements du centre de gravité dans le corps de l'homme pendent les actes de la locomotion. C. R. Acad. Sc. Paris, 1887, 105, 679-682.

Dubois, Raymond R. Spezielle Muskelphysiologie oder Bewegungslehre. Berlin, 1903.

_____ Handbuch der Physiologie des Menschen (W. Nagel, ed.) 1909, 4, 564-628.

_____ Beitrag zur Lehre von Stehen. Arch. Anat. und Physiol., physiol. Abt., 1897, 376-378.

_____ Die Grenzen der Unterstützungsfläche beim Stehen. Arch. Anat. und Physiol., physiol. Abt., 1900, 562-564.

Duncan, J. M. Researches in obstetrics. Edinburgh, 1868.

Fischer, O. Mechanismus zur Bestimmung der Lage des Schwerpunktes des menschlichen Körpers und seiner Teile. Deutsch. Math. Vers. Katalog Mathem. Modelle. 1892. (Cited by Scheidt, '22.)

_____ Ein zweiter Mechanismus zur Bestimmung der Lage des Schwerpunktes eines Systems von in beliebiger Weise miteinander durch Gelenke verbundenen Körpern. Deutsch. Math. Vers., Nachtr., Katalog mathem. Modelle. 1893. (Cited by Scheidt, '22.)

_____ Über Grundlagen und Ziele der Muskelmechanik. Arch. Anat. und Physiol., anat. Abt., 1896, 363-377.

_____ Spezielle Bewegungslehre. In Handb. der physiologischen Methodik, 1911, Pt. 1, II, 3 Abt., 121-316.

_____ Der Gang des Menschen. II. Teil: Die Bewegungen des Gesamtschwerpunkts und die äusseren Kräfte. Abh. d. mathem. -physik. Kl. Sächs. Akad. Wiss., 1899, 25. (Cited by Scheidt, '22.)

Griffith, W. S. A. An investigation of the causes which determine the lie of the fetus in utero. J. Obst. and Gyn. British Emp., 1915, 27, 105-123. Also Lancet, 2, 319-325.

Harless, E. Lehrbuch der plastischen Anatomie. Stuttgart,

1876, 301-416.
_____ Die statistichen Momente der menschlichen Gliedmassen. Abhandl. mathem. -physik. Kl. Bayer. Akad. Wiss., 1857, 8, 69, 257. (Cited by Scheidt, '22.)
_____ Kl. Bayer. Akad. Wiss., mathem. -physik., 1860, 8.
Harris, J. A. The correlation between a variable and the deviation of a dependent variable from its probable value. Biometrika, 1909, 6, 436-443.
Haycraft, J. B. Text-book of physiology (ed. by E. A. Schafer), 1900, 2, 257-263. (Summary of work of Haycraft and Sheen.)
Hesser, C. Center of gravity in the erect posture. (Swedish.) Svenska läk. -sällsk. handl., 1918, 44, 133-168, Stockholm.
Horner, F. Über die normale Krümmung der Wirbelsäule. Arch. Anat. und Physiol., 1854, 478-511.
Hrdlička, A. Anthropometry. Philadelphia, 1920.
Kohlrausch, R. Physik des Turnens. 1887. (Cited by du Bois-Reymond in Handbuch der Physiologie des Menschen, W. Nagel, ed.)
Luciani, L. Human physiology, 1915, 3, 107-113 (English transl. by Welby consulted.)
Meyer, H. Das aufrechte Stehen. Arch. Anat. und Physiol., 1853, 9-44.
_____ Die Mechanik des Kniegelenks. Arch. Anat. und Physiol., 1853, 497-547.
_____ Die wechselnde Lage des Schwerpunkts im menschlichen Körper. Leipzig, 1863. (Cited by Scheidt, '22.)
_____ Die Statik und Mechanik des menschlichen Knochengerüstes. Leipzig, 1873.
Mosso, A. Application de la balance a l'étude de la circulation du sang chez l'homme. Arch. Ital. Biol., 1884, 5, 130-143.
_____ Die Furcht. Leipzig, 1889. (English translation as 'Fear', by Lough and Kiesow, London, New York, and Bombay, 1896, consulted.)
Palmer, C. E. Center of gravity of the human body during growth. 1. An improved apparatus for determining the center of gravity. Am. J. Phys. Anthrop., 1928, 11, 423-455.
_____ The center of gravity in the developmental period of man. Anat. Record, 1929, 42, 31. (Abstract.)
Reed, L. J. Fitting straight lines. Metron, 1921, 1, 55-60.
Resmark, T. The direction of the center of gravity and significance in the erect position. (Swedish.) Svenska läk. -sällsk. handl., 1917, 43, 847-883.
_____ Center of gravity in the erect posture. (Swedish.) Hygeia, 1918, 80, 781-807.
Reynolds, E. and Lovett, R. A method of determining the position of the center of gravity in its relation to certain bony land-

marks in the erect position. Am. J. Physiol., 1909, 24, 286-293.

Richer, M. P. Sur la détermination expérimentale de la ligne de gravité du corps dans la station droite. O. R. Soc. Biol., Paris, 1894, 46, 206-207.

Rojansky, V. Note on the calculation of standard deviations. Am. Math. Monthly, 1928, 35, 132-134.

Scammon, R. E. and Calkins, L. A. Simple empirical formulae for expressing the lineal growth of the human fetus. Proc. Soc. Exp. Biol. and Med., 1923, 21, 253-356.

_____ The development and growth of the external dimensions of the human body in the fetal period. Minneapolis, 1929.

Schatz. Über dem Schwerpunkt der Frucht. Cent. Gynäkol., 1900, 40, 1033-1036; also Wiener med. Woch., 1901, 51, 161-164.

Scheidt, W. Untersuchungen über die Massenproportionen des menschlichen Körpers. Z. Konstitutionale, 1922, 249-268.

Simpson, J. Y. The attitude and position of the foetus in utero. Monthly J. Med. Sc., 1849, 423-441, 639-655, 863-886.

Solis, L. A. Determination experimental de la situacion del centro de gravedad en el cuerpo humano. Proc. Pan-Amer. Sc. Cong., Santiago de Chile, 1910, 2 (5th sect.), 514-564.

Stratz, C. H. Lebensalter und Geschlechter. Stuttgart, 1926.

Symington, J. The topographical anatomy of the child. Edinburgh, 1887.

Todd, T. W. The reliability of measurements based upon subcutaneous bony points. Am. J. Phys. Anthrop., 1924, 8, 275-279.

Todd, T. W. and Lindala, A. Dimensions of the body: whites and American negroes of both sexes. Am. J. Phys. Anthrop., 1928, 12, 35-119.

Weber, E. Über die Ursachen der Blutverschiebung im Körper bei verschiedenen psychischen Zuständen. II. Untersuchungen mit Mossos Menschenwage über die Verschiebung des Schwerpunkts des Körpers. Arch. Anat. Physiol., physiol. Abt., 1907, 326-348.

Weber, W. Gesammelte Werke. Herausg. Ges. Wiss., Göttingen, 1894, 6, 81.

Weber, E. und Weber, W. Mechanik der menschlichen Gehwerkzeuge. Göttingen, 1836. (Cited by Croskey, etc., '22, and by Luciana, '15, Human physiology.)

Williams, J. W. Obstetrics, ed. 2, 1909, Chapter 9. (Cited by Barnum, '15.)

CHILD DEVELOPMENT

Table 9

Observations upon the transverse and frontal planes of gravity, age, weight, stature, pubic and sitting heights, arm and leg lengths and anteroposterior and transverse diameters of the pelvis and chest for living subjects

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters: Transverse Pelvis	Diameters: Transverse Chest	Diameters: Anteroposterior Pelvis	Diameters: Anteroposterior Chest	Plane of gravity: From soles	Plane of gravity: From back at 25°	Plane of gravity: From back at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
17- 9	73.65	161.6	96.1	-	-	-	29.5	26.5	19.2	21.1	103.1	10.0	10.1
17- 7	81.04	179.4	94.9	-	-	-	28.4	31.2	18.6	20.9	100.4	10.1	10.3
17- 8	64.53	179.1	93.6	-	-	-	27.0	25.8	17.5	17.0	99.8	9.3	9.7
16- 8	69.51	179.1	92.4	96.7	82.6	97.4	27.9	28.3	20.3	20.2	100.8	10.7	10.7
25- 9	68.61	178.8	80.0	-	-	-	-	-	-	-	102.8	9.5	9.0
17- 1	66.91	178.8	91.7	95.6	79.6	97.1	27.7	27.5	18.8	19.5	99.8	9.2	9.4
18- 4	76.50	178.4	94.9	-	-	-	26.0	28.0	18.5	19.2	99.7	10.0	10.3
16- 9	68.38	178.4	91.7	93.3	78.0	93.5	26.5	27.5	19.1	21.0	100.4	10.2	10.8
17- 0	65.72	178.1	93.3	91.4	81.5	94.0	26.3	26.8	19.3	19.3	97.3	10.2	10.3
19- 1	68.27	177.2	92.7	-	-	-	29.3	28.0	18.5	17.0	99.3	9.8	10.2
18- 5	72.80	176.8	94.0	-	-	-	27.5	28.0	18.6	19.0	100.0	10.2	10.6
15- 6	62.43	176.8	91.4	94.5	78.8	93.0	27.7	26.0	19.0	21.0	97.9	9.3	9.3
16-11	53.24	176.5	85.1	98.7	79.2	100.3	25.1	25.0	18.3	18.4	100.8	9.7	10.1
15-10	61.58	176.2	88.6	96.6	78.8	96.1	23.0	24.7	19.4	19.6	98.6	10.1	10.3
16- 8	69.34	175.9	92.0	91.4	76.5	100.6	27.5	30.0	20.2	19.9	99.2	10.5	10.2
15- 2	71.27	175.3	92.7	93.5	79.8	93.8	19.8	21.3	18.0	17.5	98.6	9.9	10.1
18- 2	69.06	175.3	89.8	-	-	-	26.0	28.5	20.0	19.4	99.3	11.4	11.0
17- 4	66.23	174.9	88.2	94.9	80.9	95.7	27.6	26.5	19.5	17.8	99.4	9.9	10.1
19- 7	65.66	174.3	91.7	-	-	-	27.5	27.0	19.1	17.8	97.9	10.0	9.9
16-10	62.71	174.3	91.4	92.5	77.4	90.8	27.0	26.7	18.6	18.2	98.5	10.2	10.4
18- 2	63.28	174.0	88.9	-	-	-	27.2	27.5	18.4	16.6	99.6	10.3	10.4
15- 7	58.00	174.0	89.5	95.1	78.4	95.9	27.0	27.8	19.0	18.0	101.7	8.7	9.2
16- 0	61.46	174.0	89.8	92.8	80.3	93.9	26.2	25.5	20.3	19.0	98.8	9.7	10.0
17- 4	66.74	174.0	90.5	92.9	78.9	91.6	28.6	27.5	18.7	20.0	96.8	9.3	9.4
17- 9	61.80	173.7	90.5	-	-	-	28.3	28.7	18.0	18.0	97.6	8.9	9.1
16-11	59.65	173.4	91.1	-	-	-	26.1	27.0	18.0	20.0	98.8	9.7	9.6
16- 4	64.36	173.4	90.8	91.4	78.1	90.7	27.0	28.3	18.5	19.8	97.7	10.2	10.1
15- 7	64.92	173.4	88.6	94.3	79.9	94.7	27.5	28.5	19.4	20.7	98.6	9.2	9.5
17- 8	56.47	173.4	89.8	-	-	-	26.7	25.5	17.0	17.7	97.5	9.3	9.2
17- 4	71.10	172.7	93.0	-	-	-	26.8	29.0	17.0	18.3	96.3	9.9	10.3
17-10	63.84	172.4	93.3	-	-	-	26.0	27.5	17.5	19.0	96.5	9.7	10.1
16- 0	60.22	172.4	84.4	96.3	78.0	97.9	26.0	26.0	19.4	18.7	97.7	9.3	10.0
15- 2	56.93	172.1	90.5	-	-	-	24.9	24.8	18.3	17.5	96.5	8.9	9.2
14- 7	58.86	172.1	89.2	92.7	77.3	91.0	26.0	26.4	18.4	17.8	95.9	9.0	9.0
16- 3	57.72	172.1	87.3	91.4	78.1	92.7	25.0	27.0	19.2	18.6	97.2	10.1	9.5
16- 2	67.70	171.8	92.0	88.7	76.8	90.6	26.2	26.0	18.9	19.1	95.7	10.1	10.1
18- 6	62.14	171.5	85.7	-	-	-	27.7	27.2	17.9	18.3	97.6	9.8	9.6
16- 5	54.66	171.5	83.8	96.1	80.2	96.5	25.2	25.5	18.0	19.4	98.5	8.3	8.6
18- 0	67.30	171.5	91.4	-	-	-	27.0	26.0	18.5	17.4	96.7	10.0	10.2
15- 9	55.45	171.5	88.6	91.7	76.3	92.6	25.4	26.0	18.4	17.6	95.7	9.1	9.6
14- 2	52.84	171.1	88.6	89.3	75.4	90.0	25.4	26.6	19.0	18.8	96.7	9.5	9.4
16- 2	51.31	171.1	92.4	89.4	72.5	87.0	25.6	24.2	17.6	17.8	94.5	8.5	9.1
15- 3	56.93	171.1	87.6	91.2	76.7	91.1	24.9	26.6	19.1	18.0	96.3	9.7	9.5
17- 4	65.04	171.0	88.2	90.0	80.9	90.7	28.2	27.7	19.0	19.1	96.7	10.1	9.9
18- 1	58.69	170.8	89.8	-	-	-	26.5	27.3	17.2	18.0	97.4	9.8	9.9
16-10	68.04	170.8	92.7	-	-	-	25.7	28.5	18.3	19.3	95.3	11.1	10.8
16- 9	60.27	170.5	88.2	91.4	74.6	90.6	25.9	26.0	18.2	19.3	95.5	9.4	9.6
16- 8	63.05	170.2	88.9	89.0	73.3	89.6	27.0	26.0	19.2	18.5	95.0	9.8	10.5
18- 6	71.56	169.9	91.1	-	-	-	25.6	28.0	18.7	19.0	94.8	9.3	9.9
15- 8	53.53	169.9	84.4	94.7	80.3	95.1	25.3	23.0	18.3	18.0	97.4	9.4	9.7
17- 9	64.64	169.9	89.8	-	-	-	26.0	29.2	18.2	18.3	95.1	9.4	10.7
16- 4	55.62	169.9	90.5	-	-	-	26.4	26.0	18.0	19.0	95.1	9.4	9.6
14- 3	62.31	169.5	89.2	89.0	69.6	-	25.6	25.7	18.5	17.5	92.2	9.2	9.3
16- 3	50.46	169.5	83.8	92.3	76.9	93.1	27.5	25.7	18.1	14.8	96.0	8.2	8.6
17- 5	61.18	169.5	90.1	88.3	74.7	89.7	27.2	26.0	19.0	18.4	94.2	9.3	9.6
15- 8	55.17	169.5	88.2	88.8	77.8	90.9	25.5	24.5	17.2	18.8	94.1	9.0	9.3
18- 4	64.07	168.9	89.2	-	-	-	25.3	25.6	19.0	18.2	94.7	9.9	10.0
16- 6	61.46	168.9	86.0	-	-	-	26.0	26.3	18.4	18.0	95.7	10.7	10.2
15-11	66.11	168.9	89.8	-	-	-	26.0	28.0	17.9	19.0	95.3	9.6	10.0
16- 1	55.96	168.9	85.7	91.9	83.6	91.7	27.5	25.9	19.1	19.6	93.5	10.1	10.0
16- 6	59.42	168.9	90.1	87.6	78.6	89.0	26.8	27.0	18.4	18.5	95.4	10.1	10.7
13- 2	57.04	168.9	83.8	92.7	74.1	94.4	26.0	25.0	18.3	17.3	95.4	9.3	9.3
18- 1	67.30	168.6	86.3	-	-	-	27.7	27.0	18.2	19.8	96.6	11.8	11.0
16- 0	56.59	168.6	87.6	-	-	-	26.0	26.0	17.3	18.0	94.4	9.2	9.4
16-10	54.32	168.2	86.3	88.8	73.3	88.4	22.4	25.5	17.7	17.4	94.3	8.7	8.9
15- 4	55.34	168.2	85.4	92.1	74.1	92.2	26.2	24.7	18.6	18.5	95.0	9.5	9.3
16- 8	61.41	168.0	86.6	-	-	-	27.5	28.0	18.4	18.0	95.2	10.7	10.7
16- 3	54.89	167.6	87.3	-	-	-	26.7	25.0	17.8	18.0	95.1	9.3	9.4
18- 3	57.10	167.6	88.9	-	-	-	27.2	27.5	17.4	17.4	94.1	9.7	9.5
16- 5	61.41	167.6	85.7	88.7	74.8	88.7	25.7	27.0	19.5	19.0	94.4	10.0	10.0

Table 9 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters				Plane of gravity		
							Transverse		Anteroposterior		From soles	From back	
							Pelvis	Chest	Pelvis	Chest		at 25°	at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
16- 2	58.63	167.3	85.3	90.2	78.0	90.5	26.6	26.6	19.1	17.8	95.0	9.6	9.5
18- 8	60.56	167.3	88.9	-	-	-	26.5	26.0	17.5	18.0	95.2	9.7	9.7
14-11	54.43	167.3	85.4	91.1	77.1	91.7	25.3	25.1	17.7	17.6	95.0	9.8	9.9
15- 9	63.62	167.0	88.2	-	-	-	27.0	25.5	19.2	19.2	93.6	9.4	9.6
18- 4	59.82	167.0	87.0	88.2	74.0	88.9	26.3	26.0	-	19.8	94.4	10.2	10.2
17- 3	45.98	167.0	82.2	93.2	76.1	95.4	26.4	22.6	16.7	16.3	95.4	8.6	-
17- 2	63.22	166.8	86.0	89.2	73.4	87.9	28.3	29.8	16.4	18.4	93.4	10.2	9.8
14- 6	59.65	166.7	86.3	88.7	74.1	89.6	25.0	25.8	20.2	18.2	93.3	9.5	9.7
15- 7	59.88	166.7	85.7	90.5	76.2	90.7	25.7	25.6	18.4	17.4	92.8	8.9	9.0
17- 1	55.23	166.4	87.9	-	-	-	26.0	26.0	17.4	16.6	93.9	9.5	9.6
13- 9	52.39	166.4	84.7	88.7	75.7	90.0	24.8	24.7	17.7	16.7	93.1	8.4	8.8
14- 9	61.07	166.4	85.4	88.9	73.3	90.3	26.2	26.4	19.4	19.3	93.4	10.2	10.2
16- 8	65.89	166.4	88.2	86.6	73.1	86.7	28.9	19.6	16.8	-	94.3	10.6	10.4
16- 2	53.58	166.1	85.1	88.5	75.1	87.2	26.0	25.7	18.0	17.1	92.1	9.3	9.5
17-10	55.79	165.7	87.3	-	-	-	26.0	28.0	16.8	16.0	92.4	9.8	9.7
14- 2	57.72	165.7	89.5	84.6	70.9	84.6	25.0	23.8	19.1	19.4	92.4	9.9	10.1
16- 8	54.32	165.7	87.6	87.3	74.1	87.5	26.5	26.7	18.0	19.0	92.1	9.7	9.4
15-11	49.39	165.4	87.0	86.4	74.4	86.4	25.2	25.0	17.3	18.5	92.0	8.6	8.7
14- 3	47.23	165.4	87.0	88.7	73.9	90.7	24.1	24.5	17.2	16.3	93.1	8.5	8.9
18- 2	60.67	165.1	88.6	-	-	-	28.2	25.3	17.6	17.9	92.1	9.6	10.1
16- 2	59.93	165.1	85.4	-	-	-	27.2	25.4	17.8	19.0	94.1	10.6	10.4
14- 4	47.97	165.1	82.5	87.7	72.3	90.1	26.5	25.8	17.2	18.0	92.5	8.9	8.8
16- 3	61.69	165.1	84.4	87.3	73.9	86.9	27.1	27.0	18.8	18.0	92.5	9.5	9.6
18- 4	49.67	164.8	82.5	90.4	74.2	91.8	26.0	24.5	16.8	16.8	94.0	8.3	8.5
17-10	72.58	164.8	87.6	-	-	-	28.9	28.5	19.0	20.1	93.0	10.1	10.1
16- 7	50.80	164.5	86.3	85.7	68.6	86.3	24.4	26.2	18.1	16.3	91.1	9.5	9.3
17- 7	61.92	164.5	88.2	-	-	-	25.2	26.0	17.5	20.0	92.4	9.6	9.9
1[illegible]- 8	59.31	163.8	84.4	-	-	-	26.3	26.5	17.6	18.3	92.9	10.2	10.4
15- 4	53.78	163.8	80.6	88.7	75.3	89.2	26.4	24.2	18.6	17.5	92.4	9.1	9.6
15- 6	54.66	163.2	82.8	89.7	74.7	90.5	24.0	24.6	18.3	19.2	92.5	9.6	9.7
15- 2	50.24	163.2	85.1	87.2	84.8	87.2	26.7	23.0	18.2	17.1	92.6	9.1	9.3
15- 4	57.04	163.2	83.8	87.9	74.0	89.9	26.2	26.0	18.3	19.5	92.0	10.4	10.5
18- 8	62.14	162.9	87.0	-	-	-	26.6	27.7	18.2	18.3	92.8	9.7	9.8
14- 5	53.13	162.9	83.2	87.4	72.3	88.9	25.6	26.0	18.5	17.3	91.4	10.1	10.0
14-11	50.52	162.6	83.2	87.5	74.6	88.7	27.4	26.0	18.5	16.8	92.3	8.8	9.0
17- 5	48.59	162.6	84.1	-	-	-	23.5	25.6	16.4	15.5	93.9	9.2	9.7
15- 9	49.44	162.6	84.4	86.1	73.2	85.1	25.0	26.0	17.6	16.8	91.5	8.7	9.3
14- 6	52.62	162.6	86.0	84.0	72.2	83.7	24.0	26.0	18.5	17.0	91.8	9.8	9.5
15-10	52.62	162.2	86.3	83.3	74.8	84.7	26.3	24.8	18.3	16.5	91.3	9.0	8.8
15-10	48.08	161.3	80.6	88.6	71.3	89.0	24.5	24.2	17.5	16.3	92.0	9.1	9.3
14- 2	53.24	161.3	82.2	86.3	73.3	89.4	25.3	24.0	17.3	19.3	90.4	9.9	10.1
16- 1	51.31	161.3	87.6	83.0	74.9	82.5	25.0	25.5	17.0	20.0	92.8	8.8	8.9
13-11	45.36	161.3	80.6	88.7	71.9	90.4	24.6	24.2	16.7	16.8	93.4	9.1	9.2
14- 7	47.06	161.0	82.2	85.7	74.2	86.7	24.7	24.5	18.2	17.1	91.3	8.8	9.0
14- 8	49.95	161.0	84.1	82.5	73.5	86.8	25.3	25.1	17.2	16.7	90.4	8.2	8.6
13- 3	49.44	161.0	83.8	85.1	74.0	86.8	25.0	26.5	18.0	18.8	94.0	9.2	9.8
13-11	45.42	160.9	83.2	85.1	72.2	85.9	24.6	24.0	15.5	17.0	90.9	9.0	9.4
13-10	46.21	160.3	83.2	84.1	72.4	86.4	24.0	24.2	15.3	16.2	90.8	8.5	9.0
16- 9	51.03	159.7	85.1	84.7	73.9	85.5	27.1	25.0	17.5	17.0	89.0	8.6	8.8
14- 0	51.65	159.4	78.1	89.1	69.4	88.7	23.6	25.5	19.4	19.7	91.9	8.6	8.8
17- 6	44.34	159.4	83.8	-	-	-	23.9	23.2	15.0	16.5	89.9	8.7	8.6
15- 9	41.39	159.4	80.0	-	-	-	23.5	23.5	15.6	14.0	91.6	8.4	8.5
16- 5	47.80	158.8	84.7	82.2	69.8	84.7	24.5	25.0	17.1	17.0	90.1	8.4	9.4
16- 2	51.03	158.8	79.7	87.7	70.7	88.5	23.5	25.1	17.6	18.6	90.9	8.8	8.9
15- 7	44.51	158.1	80.0	84.6	73.4	86.9	25.3	22.6	17.0	18.0	90.5	8.7	9.1
14- 8	47.14	157.8	81.3	84.1	71.7	86.0	24.0	24.5	16.6	17.3	89.7	8.4	8.9
12- 7	41.96	157.8	81.3	82.6	67.5	84.6	22.6	23.0	17.3	16.4	89.0	10.2	10.8
13- 5	41.85	157.5	78.7	86.0	70.3	87.3	23.6	23.6	16.6	15.6	89.6	8.2	8.4
14- 9	47.29	157.5	83.2	82.2	70.1	84.3	25.5	26.7	17.3	17.0	89.3	9.3	9.5
12-10	44.11	157.5	83.2	81.6	68.6	85.9	23.4	22.5	17.0	16.0	88.3	8.9	9.3
15- 5	49.16	157.2	82.5	81.9	69.1	84.0	25.4	24.0	18.2	19.0	88.3	9.7	9.3
14- 8	44.45	156.5	81.3	79.4	70.7	83.5	24.2	25.0	16.5	15.8	87.6	10.0	9.8
13- 5	43.38	155.9	80.6	81.6	69.5	83.6	21.6	22.5	16.6	16.6	87.1	8.7	9.4
13-10	46.04	155.6	77.8	85.5	69.1	86.7	23.8	24.6	16.5	16.0	88.8	7.9	8.5
12- 7	42.47	155.2	74.9	82.2	69.0	86.0	23.8	24.4	16.4	-	88.2	9.3	9.1
13- 3	43.49	155.2	77.8	82.4	69.7	84.0	23.7	24.1	15.3	15.0	86.6	8.2	8.3
14- 4	47.52	154.9	79.0	83.9	68.8	85.7	25.1	25.6	16.5	17.2	87.8	9.7	9.3
13- 3	39.35	154.9	78.1	83.3	67.5	84.6	24.0	23.4	16.0	14.7	87.7	7.6	7.7
12- 6	44.00	154.6	81.6	81.1	68.1	82.0	23.4	23.0	17.5	16.7	87.1	8.8	9.5
10-11	36.74	154.3	77.1	81.6	69.3	84.5	23.0	22.0	15.2	16.5	88.9	8.6	8.4
11- 6	40-54	154.3	79.0	81.1	68.2	83.9	23.8	22.4	16.5	16.5	86.1	7.8	8.0
14- 2	40.71	154.3	77.5	79.8	69.0	82.4	23.0	25.6	16.3	14.6	86.7	8.2	8.3
13- 3	46.78	154.0	77.4	85.3	71.8	86.9	23.0	22.6	16.0	17.0	87.3	8.4	8.7
12-10	42.70	153.7	78.1	80.9	67.4	83.1	22.6	23.6	15.6	15.6	86.6	8.2	8.6
16-10	52.28	153.7	83.2	78.9	66.1	79.0	23.6	26.7	17.8	19.2	85.5	9.6	9.7
13-11	37.71	153.7	75.9	83.4	68.4	85.9	23.5	22.2	16.0	15.6	89.1	8.6	9.0
12- 9	41.28	153.7	81.6	79.1	69.3	80.0	25.0	23.4	16.6	15.6	85.1	7.7	8.3
12- 7	47.52	153.4	79.3	80.6	69.5	83.0	25.7	25.6	17.0	17.0	87.1	9.2	9.2
13- 3	43.66	153.0	77.4	80.5	71.0	83.6	24.0	23.5	15.7	16.0	85.7	8.6	8.8
15- 7	46.04	153.0	78.4	-	-	-	23.6	24.5	14.5	16.5	87.4	8.7	8.6

Table 9 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters: Transverse Pelvis	Diameters: Transverse Chest	Diameters: Anteroposterior Pelvis	Diameters: Anteroposterior Chest	Plane of gravity: From soles	Plane of gravity: From back at 25°	Plane of gravity: From back at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
12- 7	38.10	153.0	78.1	81.4	68.8	83.8	23.0	22.6	15.0	15.0	86.9	7.5	7.7
12-10	39.41	153.0	78.7	78.5	68.9	80.6	22.5	23.0	15.6	14.5	85.6	8.5	8.5
12- 1	39.12	153.0	77.5	80.2	67.9	84.3	22.6	23.0	16.2	15.5	85.6	8.2	8.1
14- 2	50.58	153.0	79.3	79.5	69.3	81.7	24.0	25.0	18.8	17.3	84.8	8.8	8.8
12- 8	41.62	152.7	74.3	80.5	68.5	82.2	22.0	22.7	16.7	15.4	85.6	9.1	9.3
13- 5	39.92	152.7	75.5	82.1	69.5	83.4	22.3	21.7	16.0	17.3	86.9	7.9	8.1
15- 5	39.80	152.4	78.7	80.7	78.7	81.7	22.0	22.3	16.2	17.0	86.2	9.0	9.7
11-11	41.11	152.4	78.7	80.5	67.9	81.7	24.0	23.5	16.2	15.5	85.6	8.7	8.9
12- 9	41.39	152.1	78.7	79.0	67.5	81.7	21.9	22.2	15.7	16.0	85.3	8.9	8.8
13- 1	45.47	152.0	76.5	80.9	66.6	82.0	23.2	23.4	16.5	15.2	85.2	8.7	8.8
13- 8	45.81	151.8	78.4	80.8	67.6	82.7	25.0	23.5	17.8	17.5	85.2	9.1	8.8
14- 0	44.45	151.8	77.1	80.8	68.3	82.7	23.5	24.0	15.5	15.5	85.9	8.0	8.4
12- 6	38.67	151.8	77.4	81.6	66.2	83.6	23.0	22.5	16.0	16.5	85.4	8.1	8.0
13- 4	40.03	151.8	80.4	78.8	66.0	79.6	22.5	23.0	15.2	17.0	85.4	8.4	8.9
14- 9	44.23	151.8	77.1	80.8	68.0	80.7	23.8	24.0	17.2	16.8	85.3	8.0	8.9
14- 1	39.97	151.7	76.5	79.4	66.8	80.6	22.6	23.5	15.2	14.3	85.0	8.3	8.4
12- 4	34.81	151.1	75.5	79.0	70.6	83.2	23.0	22.0	15.0	13.5	86.2	8.3	8.2
11-11	40.14	151.1	75.5	79.1	67.2	82.3	23.4	22.5	15.6	15.0	84.7	8.5	8.5
14- 5	39.24	151.1	77.1	80.3	68.8	81.0	22.8	22.6	15.0	17.0	85.2	8.2	8.1
13- 8	33.11	150.8	75.2	-	-	-	23.0	22.0	13.6	13.0	85.5	8.6	8.5
14- 3	37.93	150.5	75.5	81.4	67.3	83.8	22.0	23.0	16.0	15.6	84.7	8.7	8.6
15- 2	45.13	150.5	77.4	79.8	66.5	80.7	22.5	24.3	17.6	17.0	85.8	8.8	9.4
12- 0	38.95	150.2	78.1	78.7	66.0	80.2	23.6	22.0	15.0	15.0	85.0	7.5	7.6
11- 4	41.08	150.2	76.5	79.5	62.8	80.7	21.9	21.7	15.1	15.9	84.0	7.8	8.2
12- 1	43.09	150.2	72.6	79.5	66.8	81.9	32.7	22.5	16.4	16.5	83.7	9.2	9.4
12- 5	39.86	149.9	75.5	77.7	65.2	80.1	22.3	22.2	16.2	16.0	82.7	8.1	8.3
11- 7	39.29	149.9	78.4	77.8	66.6	77.9	24.5	23.4	15.5	14.7	83.6	8.0	8.2
14- 2	40.37	149.9	75.5	79.7	66.1	81.6	24.6	23.0	14.7	15.6	85.0	8.8	9.1
13- 6	35.78	149.5	74.9	81.8	66.1	82.4	23.0	23.7	15.0	14.7	85.8	7.8	8.0
12- 9	37.48	149.5	72.0	79.9	67.3	80.8	24.0	23.2	15.5	17.0	84.9	8.4	7.7
12- 6	39.21	151.7	74.3	81.2	71.1	83.3	24.0	24.0	15.5	15.0	86.4	8.2	8.4
13- 0	36.18	149.2	72.7	76.3	64.2	78.1	22.2	21.0	14.2	15.5	82.1	8.2	8.1
13- 5	36.23	149.2	76.5	-	-	-	22.0	21.4	14.5	15.7	85.2	8.0	8.1
13- 2	43.60	149.2	75.5	81.1	65.5	82.9	24.0	24.2	16.2	15.5	85.6	8.6	8.7
12- 9	42.73	149.2	77.4	76.1	63.6	77.6	24.0	23.6	16.4	15.6	83.6	8.7	9.3
10- 6	39.46	148.9	77.4	78.5	66.6	79.7	22.0	23.8	16.0	15.0	84.1	8.0	8.2
14-10	39.52	148.6	74.9	80.7	66.3	81.3	22.0	22.7	15.6	16.1	85.6	8.5	8.8
13- 4	39.46	148.6	78.6	76.9	62.9	78.9	22.5	24.4	16.0	16.4	85.0	9.2	10.9
13-11	42.46	148.6	76.2	77.8	69.1	81.4	23.0	24.0	15.4	17.0	84.2	8.8	9.3
13- 9	39.92	148.6	78.4	74.8	63.9	78.0	21.0	22.0	16.0	17.2	83.5	9.2	9.3
11- 3	33.34	148.3	75.9	79.7	64.5	80.0	23.5	20.8	14.7	14.6	83.3	7.1	7.4
11-11	41.07	148.3	76.2	79.5	64.6	81.2	23.2	22.6	16.7	17.0	84.0	8.3	8.4
11- 3	38.22	148.0	74.9	77.4	64.7	80.8	22.5	22.0	15.6	15.5	83.2	8.4	8.4
13-11	36.29	148.0	78.4	75.0	65.4	77.4	22.8	23.0	16.0	16.0	84.2	7.7	7.9
12- 6	39.35	148.0	78.7	76.5	66.7	78.1	22.5	23.0	15.0	17.0	83.7	8.4	8.9
12-10	39.86	148.0	73.0	81.4	70.5	84.2	24.6	24.0	15.6	16.6	84.0	7.9	8.1
11-11	37.14	148.0	74.3	79.9	67.3	81.6	21.4	21.6	15.7	15.7	83.8	8.3	8.1
14- 4	40.77	148.0	73.3	81.8	68.9	82.4	22.0	23.0	16.7	16.0	83.4	7.6	8.0
15- 5	38.39	147.6	71.4	82.2	66.1	83.5	21.0	22.0	16.5	16.4	85.1	8.5	8.8
12- 9	34.59	147.6	74.9	77.0	64.5	78.1	21.0	23.7	15.0	16.0	83.3	8.5	8.2
13-11	37.31	147.3	73.6	77.1	65.2	80.0	24.3	22.6	15.6	15.0	82.7	7.6	7.6
13- 3	31.42	147.3	75.2	78.7	64.7	79.0	22.0	21.7	14.6	15.0	83.2	8.3	8.0
13- 1	35.66	147.3	78.1	77.3	54.7	78.7	23.1	23.2	14.0	15.0	83.5	7.4	7.7
12-11	37.08	147.0	76.2	76.9	66.2	80.0	22.0	22.3	16.0	15.2	83.8	7.8	7.9
11- 9	37.20	146.7	76.8	76.1	63.5	77.5	23.5	22.5	15.6	16.0	83.3	8.6	8.6
11- 6	37.20	146.7	73.0	77.6	66.9	80.7	23.5	23.0	15.0	14.7	83.6	8.9	8.8
11- 8	35.27	146.7	73.0	78.2	64.5	79.5	24.3	22.0	14.6	14.1	82.6	7.6	-
11- 6	35.83	148.6	74.3	78.5	65.8	79.4	21.8	21.8	15.8	14.5	84.9	8.4	8.0
11- 6	33.85	146.3	73.7	76.6	64.5	76.3	20.4	21.1	15.2	15.1	82.4	7.4	7.0
11- 0	42.30	146.3	74.9	77.0	65.3	79.8	24.0	23.2	17.6	15.6	83.2	8.5	8.7
11- 4	35.01	146.1	76.5	76.8	65.3	77.1	21.6	23.2	15.0	14.6	84.5	7.9	8.0
12- 1	37.37	146.1	78.1	75.2	65.9	76.7	22.5	22.6	15.6	15.6	83.1	8.3	7.9
12- 3	37.82	146.1	78.1	75.1	66.4	77.1	22.0	22.2	14.1	16.0	81.0	7.6	8.3
12- 7	41.50	146.1	76.5	76.3	65.5	77.0	24.0	23.7	16.0	16.5	82.2	8.7	9.2
12- 0	37.93	146.1	79.3	75.2	62.5	75.9	23.2	22.3	15.6	16.2	81.0	8.0	7.9
12- 2	33.68	146.0	74.0	74.4	64.0	77.7	22.0	21.1	15.1	14.0	82.8	8.7	8.5
12- 3	36.74	145.7	74.6	75.7	64.4	78.3	24.0	22.3	15.0	15.1	83.6	8.6	8.5
12- 1	34.64	145.4	81.9	77.0	64.8	79.6	23.0	22.0	15.0	14.0	83.1	7.9	8.2
13- 0	34.76	145.4	72.4	76.5	67.1	77.8	21.2	21.7	15.0	14.5	82.5	9.5	8.8
10- 6	35.38	145.4	73.0	74.4	62.8	75.0	22.5	23.0	16.1	13.8	79.7	7.9	7.9
13- 0	35.27	145.4	76.2	76.2	66.4	78.7	21.5	22.2	15.8	16.4	83.1	8.2	8.2
13- 5	38.73	145.4	74.3	78.6	64.0	81.1	23.5	21.0	16.4	16.0	82.6	8.0	8.0
13- 9	37.31	145.1	74.6	76.3	66.0	78.1	21.4	22.9	14.0	15.8	82.2	8.1	7.8
11- 1	31.49	144.8	77.8	74.2	62.5	75.3	21.4	19.0	14.4	13.0	80.7	8.1	8.6
13- 4	40.99	144.8	73.3	76.6	64.2	78.4	23.0	24.0	15.0	15.5	82.2	8.5	8.6
15- 3	38.78	144.8	76.2	75.4	62.9	77.5	22.0	23.0	15.3	17.0	80.8	8.1	8.4
7-11	40.48	144.8	75.5	76.4	65.1	77.1	24.0	23.4	16.6	16.0	82.3	8.9	9.0
12- 6	34.36	144.8	75.5	75.8	64.5	78.2	23.6	23.4	14.7	15.8	82.1	8.6	8.8
11- 8	32.77	144.8	72.4	75.0	63.4	77.4	22.4	23.0	14.4	14.6	83.1	8.7	8.6
12- 2	35.55	144.8	71.1	76.1	65.9	79.5	21.7	22.6	15.6	15.2	83.2	8.4	8.3

Table 9 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters: Transverse Pelvis	Diameters: Transverse Chest	Diameters: Anteroposterior Pelvis	Diameters: Anteroposterior Chest	Plane of gravity: From soles	Plane of gravity: From back at 25°	Plane of gravity: From back at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
12- 0	32.89	144.4	80.9	75.5	65.3	77.5	22.2	21.0	15.5	15.5	82.2	8.5	8.5
12- 6	33.45	144.4	72.7	74.9	66.8	77.0	23.7	24.2	14.6	16.0	83.3	8.0	7.8
10-11	42.30	144.1	76.8	75.3	62.5	-	24.0	21.5	16.0	16.1	79.6	8.2	8.3
10- 9	31.53	144.1	74.9	74.7	62.6	74.9	21.5	20.5	15.5	15.0	80.9	7.7	7.5
13- 0	35.72	144.1	74.6	76.1	62.0	76.9	21.9	22.9	14.4	15.5	82.6	8.4	8.4
12- 6	39.35	144.1	75.2	72.6	65.6	75.3	22.5	23.0	16.0	15.0	80.6	8.0	8.5
11- 0	31.21	144.1	71.7	74.3	62.5	76.0	22.2	21.1	13.9	13.8	81.5	7.9	7.9
11- 9	34.02	143.8	73.7	73.7	61.8	75.5	22.0	23.5	14.8	15.0	80.7	8.9	8.3
13- 5	38.39	143.8	76.2	74.3	62.2	77.7	22.2	23.5	15.0	15.2	80.9	8.3	9.0
15- 0	38.95	143.8	73.3	76.6	65.8	77.7	22.5	24.7	14.6	14.8	81.6	8.3	8.5
10- 8	37.99	143.5	75.5	73.5	66.3	77.0	22.4	22.5	15.3	15.0	82.2	8.5	8.4
11- 4	33.23	143.5	73.6	75.0	66.2	78.1	21.2	21.2	15.2	15.0	82.6	8.1	8.3
9- 0	32.49	143.2	75.5	-	-	-	22.2	20.4	14.0	13.0	80.6	7.5	7.8
10- 7	36.35	143.2	75.5	74.7	63.7	76.0	22.0	24.2	14.7	14.2	82.1	8.2	7.8
11-11	34.30	142.9	75.9	74.5	63.4	75.5	23.4	22.8	14.8	14.2	81.6	7.9	7.7
14- 4	30.73	142.9	73.6	76.4	64.0	77.7	19.0	20.0	14.6	15.1	81.7	7.5	7.6
11- 3	33.57	142.9	71.7	74.6	61.9	76.7	21.3	21.0	16.1	14.0	81.1	8.2	7.6
11- 8	35.04	142.5	73.0	73.5	62.3	76.0	23.0	23.3	14.0	14.0	80.8	9.0	8.8
11- 6	35.95	142.5	73.7	73.0	63.0	76.0	22.3	21.3	14.6	15.8	80.6	8.1	8.0
12- 8	32.89	142.2	71.7	74.5	60.9	76.6	21.6	22.6	14.2	14.0	80.1	7.3	7.7
12- 2	31.81	142.2	72.7	74.6	64.9	77.2	21.7	22.0	14.8	14.9	81.7	7.8	7.7
11-10	35.21	142.2	76.8	73.6	63.5	74.7	22.5	22.0	14.5	15.2	80.8	7.4	7.7
10- 1	35.44	142.2	71.4	73.3	66.1	76.3	23.5	22.5	15.3	14.4	80.4	7.4	7.9
11-10	33.96	142.2	73.0	74.5	62.4	73.2	22.0	21.5	14.4	16.0	79.7	7.9	7.9
14- 1	37.54	142.2	72.4	74.0	64.7	77.4	23.1	23.8	15.2	16.5	80.4	8.0	9.5
10- 4	32.72	141.9	71.4	72.8	62.2	74.7	21.6	20.5	14.2	13.7	79.3	7.3	7.4
11- 4	33.51	141.6	71.1	71.9	62.1	74.4	21.6	21.4	14.0	13.9	79.1	8.2	8.0
13- 4	40.14	141.6	72.0	74.0	64.2	75.3	21.6	23.1	15.2	15.0	78.8	8.8	8.4
10- 8	32.80	141.6	77.1	72.9	60.2	73.9	21.6	21.3	14.5	14.9	80.8	7.9	7.9
10-10	30.62	141.6	73.0	73.4	61.4	74.4	21.0	21.8	14.6	14.8	81.4	7.8	7.8
10- 3	33.45	141.3	81.6	72.5	64.0	74.0	22.4	22.0	15.0	15.0	81.4	9.4	9.1
12- 6	33.23	141.3	72.4	73.1	54.1	74.0	22.5	23.1	14.5	15.2	79.3	8.8	8.2
11- 3	32.49	141.0	69.5	73.4	63.3	77.3	20.5	22.5	14.8	14.0	79.5	7.7	7.8
11- 1	35.15	141.0	76.8	72.7	64.1	74.1	22.2	22.8	15.6	14.7	79.7	7.6	8.0
12- 4	32.66	141.0	73.3	72.1	62.6	75.0	21.8	22.0	14.0	15.6	79.7	7.2	7.6
11- 9	32.12	141.0	74.9	74.8	62.9	77.6	21.5	21.5	14.0	16.0	81.6	8.2	8.5
12- 4	30.85	141.0	76.5	70.9	59.2	71.8	22.1	22.5	14.0	13.7	78.9	7.5	7.6
10- 4	30.16	140.7	73.0	73.2	63.1	74.0	21.6	21.4	13.7	14.1	80.8	8.0	7.8
12- 7	29.60	140.6	72.4	71.9	61.6	75.3	21.5	22.0	13.8	13.5	81.2	7.7	7.5
12- 1	34.25	140.6	71.4	72.9	61.7	75.1	21.4	21.3	14.4	15.4	79.5	8.0	8.0
8- 9	28.92	140.3	74.9	71.5	61.5	72.3	21.3	20.0	13.6	14.3	79.3	7.9	7.5
12- 6	32.49	140.3	74.6	73.9	65.4	75.5	22.0	22.7	15.0	15.0	78.9	7.9	7.3
12- 0	33.28	140.3	73.3	72.7	60.8	76.2	21.0	21.6	14.5	15.0	78.8	7.3	7.3
12- 2	36.23	140.3	73.0	71.5	63.2	72.9	23.6	21.0	15.2	14.5	78.1	8.1	8.3
10- 8	30.85	140.3	68.9	72.3	61.8	72.9	21.2	21.5	14.0	14.0	79.5	8.1	8.1
11- 3	30.51	140.3	70.5	71.8	62.4	74.5	20.5	21.2	14.1	14.0	79.3	8.0	7.7
12- 5	31.30	140.0	66.7	75.4	62.2	79.2	21.4	22.6	14.2	13.4	79.4	7.7	9.8
11- 8	32.66	140.0	69.5	71.9	65.4	73.9	21.6	21.7	14.6	13.6	80.0	7.8	7.8
10- 9	33.17	139.4	74.6	-	-	-	21.0	21.0	14.0	13.2	79.5	7.9	7.7
10- 9	32.66	139.4	68.6	73.1	65.0	75.6	21.4	22.5	14.5	14.5	78.4	7.5	7.2
11- 7	30.16	139.1	74.3	71.3	62.2	72.6	21.4	21.5	13.7	14.4	80.0	7.7	7.7
7- 9	30.22	138.7	76.2	-	-	-	20.6	19.2	13.0	13.5	78.5	7.0	7.4
9- 1	36.06	138.7	75.5	70.7	60.2	72.4	21.8	21.8	14.6	15.4	78.0	8.3	8.6
11- 7	29.65	138.7	72.4	73.2	61.2	76.5	23.0	20.3	14.0	14.4	79.3	7.3	7.1
11- 6	29.54	138.4	72.7	71.8	60.1	74.9	21.3	22.8	15.3	14.4	80.1	7.8	7.5
13- 6	32.21	138.4	73.0	71.9	60.8	65.0	20.2	22.0	14.6	13.6	79.0	7.4	7.5
11- 4	29.65	138.4	67.3	72.6	61.9	74.0	21.1	21.5	13.6	15.1	79.0	8.1	8.1
13- 4	29.99	138.1	73.0	71.4	61.5	73.3	21.6	21.0	13.9	14.2	78.9	8.2	8.2
11- 6	29.60	139.7	71.7	74.2	62.5	76.5	21.3	20.7	13.9	14.5	79.0	7.6	7.7
12-10	37.65	139.7	77.4	73.5	60.5	75.0	21.5	23.3	16.6	15.2	79.4	8.4	9.1
12- 2	30.68	138.1	68.9	73.0	61.6	75.3	21.5	20.0	14.4	15.8	78.4	7.4	7.3
8- 9	33.91	138.1	70.1	70.5	59.3	72.0	22.7	22.2	15.0	13.8	78.6	8.5	8.3
9-10	29.26	138.1	70.1	70.0	59.4	73.6	21.3	20.6	14.7	13.7	79.3	8.2	8.4
10- 6	33.79	137.8	73.3	69.5	56.3	70.9	22.6	22.4	14.6	13.5	76.8	8.3	7.7
8- 9	40.48	137.8	70.5	71.8	61.3	72.4	23.0	23.0	16.0	17.0	77.3	8.5	8.6
12- 2	35.49	137.8	71.4	69.8	61.7	70.9	22.8	22.5	15.1	14.6	77.7	9.2	9.2
12- 9	33.40	137.8	71.4	70.0	59.5	72.3	21.0	19.6	15.2	14.0	76.7	7.4	7.8
10- 9	32.51	137.8	73.3	71.3	60.6	72.9	21.2	20.4	14.0	13.9	77.9	7.4	7.6
11- 6	31.64	137.8	70.5	72.9	61.6	73.9	21.8	21.7	14.5	14.0	78.2	7.0	7.2
10- 3	28.58	137.8	67.9	72.2	60.2	73.5	20.6	21.2	13.2	14.3	78.1	7.2	7.3
11-10	28.24	137.5	72.0	70.7	60.4	72.4	20.4	18.9	13.5	13.5	76.3	7.3	7.5
9- 9	30.51	137.5	69.5	71.9	58.8	73.1	21.2	20.5	14.0	14.2	77.9	7.6	7.6
8- 9	28.35	137.2	70.1	69.6	58.5	72.5	21.6	21.7	14.4	14.8	77.4	7.0	6.5
10-11	31.41	137.2	68.5	72.3	61.9	72.9	20.8	20.2	14.0	14.5	78.6	7.5	7.6
10- 2	30.39	137.2	73.0	71.7	62.6	73.7	21.5	21.3	14.0	14.3	78.0	7.7	7.6
10- 7	32.89	137.0	69.9	68.8	59.8	66.9	21.7	22.0	13.5	16.0	76.3	7.8	7.4
11- 8	29.03	136.7	72.4	70.3	58.8	72.3	22.0	20.8	14.3	14.0	77.2	7.5	7.3
15- 7	28.32	136.8	72.0	63.0	60.2	71.5	21.2	20.0	15.0	14.4	77.4	8.1	7.7
10- 9	32.43	136.5	70.8	69.2	58.3	75.1	21.5	20.6	14.5	15.0	77.4	8.5	8.2
8- 8	30.39	136.5	68.2	70.1	57.9	71.7	20.5	20.0	14.5	14.0	78.3	10.0	9.7

Table 9 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters				Plane of gravity		
							Transverse		Anteroposterior		From soles	From back at 25°	at 30°
							Pelvis	Chest	Pelvis	Chest			
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
9- 3	31.30	136.5	69.8	68.9	60.8	71.4	21.4	22.3	14.5	14.0	76.0	7.6	7.5
10- 6	29.20	136.5	71.7	71.5	61.0	70.7	20.2	20.0	13.3	16.1	78.6	7.6	7.4
9- 9	29.09	136.0	70.8	71.0	56.3	71.4	20.5	20.1	14.5	13.7	76.6	7.2	7.1
8- 5	30.85	135.9	71.4	72.0	57.7	74.2	21.0	21.0	14.5	15.0	76.9	7.7	7.9
9- 2	29.60	135.9	67.9	70.7	60.2	71.7	22.2	22.7	15.0	13.7	78.6	8.2	8.0
10- 1	31.13	135.9	69.2	69.7	58.3	71.1	21.0	21.3	14.1	15.2	77.1	7.7	7.5
10-11	29.20	135.9	71.1	69.8	59.6	72.0	19.8	21.6	14.4	14.4	77.5	8.1	8.2
9- 9	29.14	135.6	72.0	-	-	-	21.4	20.5	13.4	13.5	78.6	8.6	8.4
9- 2	29.88	135.6	67.3	71.4	62.2	72.7	20.5	21.0	14.0	13.7	77.6	7.5	7.5
9- 9	29.82	135.6	68.6	68.8	61.3	72.2	20.6	20.5	14.5	13.8	76.5	7.4	7.2
10- 2	29.82	135.6	72.4	-	-	-	21.2	20.7	13.7	12.6	78.2	8.4	8.1
9- 1	30.39	135.5	71.4	71.3	60.9	71.6	21.2	20.4	13.6	14.2	76.3	7.4	7.3
9- 6	31.98	135.3	71.7	69.5	60.4	71.1	22.3	20.5	14.2	15.0	76.2	7.9	7.7
9- 7	30.16	135.3	73.6	68.5	58.4	69.4	20.4	21.5	14.0	15.0	76.9	8.1	8.2
13- 0	31.19	135.3	68.2	70.3	60.7	71.9	21.2	22.4	14.7	14.2	75.9	7.1	7.2
11- 5	29.77	134.9	71.1	71.7	60.3	72.9	21.2	22.4	13.2	13.6	78.0	7.5	5.5
11- 6	29.60	134.9	66.7	68.8	57.9	70.9	20.0	21.3	15.5	15.4	77.0	8.2	7.6
10-11	33.17	134.6	72.2	-	-	-	22.1	21.4	13.6	14.0	75.7	7.1	7.3
9- 7	24.44	134.6	67.9	69.4	57.7	71.6	19.8	19.5	13.3	12.6	77.0	7.1	6.8
9- 8	28.63	134.4	69.8	66.1	58.0	69.9	22.0	21.8	14.4	12.6	74.9	7.3	6.9
8- 9	30.68	134.3	71.1	69.6	59.9	69.6	20.3	21.6	14.5	14.6	76.2	8.2	8.4
8- 6	29.99	134.3	68.2	71.8	59.6	73.1	21.7	21.1	14.0	14.9	77.3	7.8	8.0
7- 9	28.41	134.3	72.4	68.2	57.1	69.4	20.4	19.4	14.3	14.4	76.1	7.7	7.7
7- 7	27.44	134.3	71.4	68.3	60.3	70.5	20.4	20.0	14.2	15.0	77.6	8.1	7.7
10- 6	29.60	134.3	67.6	68.5	59.4	69.2	21.2	21.0	14.4	14.0	74.8	7.4	7.4
9-11	29.48	134.0	68.0	67.6	57.3	67.8	20.2	20.3	14.6	14.6	75.2	8.1	8.2
9- 3	28.69	133.6	67.0	68.8	59.5	70.7	21.5	21.0	14.0	14.2	76.9	7.9	8.0
11- 5	30.39	133.3	67.6	67.2	59.8	70.1	21.0	21.0	14.0	13.7	75.5	7.5	7.8
11- 2	29.48	132.7	71.1	68.6	58.8	68.4	19.3	19.6	13.6	14.0	75.0	7.5	7.2
8- 5	29.03	132.7	69.8	71.5	59.4	-	21.0	21.3	14.2	13.9	75.4	7.0	7.1
8- 8	29.54	132.7	69.8	64.6	55.6	70.7	20.3	19.0	14.6	13.7	76.0	6.7	7.2
10- 4	28.24	132.7	66.7	69.3	59.8	69.9	21.0	20.4	14.7	13.5	75.3	7.5	5.7
9- 6	26.62	132.7	66.7	67.8	55.5	68.5	19.7	20.5	13.8	11.8	77.1	10.9	9.9
11- 4	27.00	132.7	66.0	68.9	58.5	72.5	20.7	19.1	13.2	13.5	74.8	6.7	6.8
11- 2	28.46	132.4	69.2	68.4	58.2	70.0	20.4	19.9	13.8	12.0	76.1	7.5	7.9
8- 8	25.40	132.4	65.4	66.4	57.9	70.2	20.6	20.6	13.0	12.6	75.7	7.5	8.3
9- 1	27.22	132.1	67.3	66.9	45.6	68.5	20.0	20.5	14.0	14.2	73.8	7.5	7.5
10-11	29.82	131.7	66.7	67.1	57.9	69.7	20.7	21.5	14.1	15.0	75.1	7.7	7.9
10- 9	37.99	131.7	66.7	68.0	56.3	64.5	21.0	22.6	16.0	14.5	74.8	8.2	8.2
9- 0	27.22	131.4	69.2	-	-	-	20.0	19.7	12.2	13.3	75.7	8.3	8.1
9-10	29.37	131.4	69.8	67.6	55.2	67.6	19.9	20.9	14.0	13.6	75.8	7.9	7.9
8- 7	25.01	131.4	67.9	66.6	57.3	68.3	18.4	20.4	13.0	12.6	75.9	9.2	8.1
10- 5	27.50	131.4	64.7	67.5	55.8	69.5	20.5	20.2	13.6	14.2	74.3	8.0	7.6
11- 0	26.20	131.4	74.0	61.1	48.4	70.9	20.7	21.0	13.0	13.5	75.9	7.2	7.4
8-10	28.97	131.4	67.9	65.6	57.4	68.3	21.0	21.0	13.1	13.7	75.1	8.0	8.2
8- 0	27.67	131.4	70.1	68.4	51.3	67.4	20.5	20.6	14.6	14.7	75.5	8.0	7.7
9- 2	28.29	131.1	70.5	67.0	57.5	66.7	20.5	20.7	13.0	13.1	75.2	7.5	7.4
11- 6	29.20	130.8	64.7	67.4	57.8	70.1	21.2	22.3	13.4	14.4	74.9	8.1	7.8
8- 2	26.03	130.8	65.4	68.2	57.7	68.9	18.3	20.0	13.4	13.6	75.6	8.2	8.0
9- 1	26.08	130.8	66.0	67.8	57.8	69.8	19.4	20.5	13.2	13.0	74.1	7.3	7.1
8- 2	27.84	130.8	72.0	65.8	57.2	66.6	21.6	20.5	13.5	13.5	74.6	8.5	7.9
9- 5	25.18	130.8	68.6	65.4	56.3	67.7	19.0	19.6	12.1	14.2	73.8	7.3	7.2
9- 9	30.85	130.8	71.4	64.8	57.1	66.2	22.0	22.1	12.6	14.0	73.9	7.8	8.0
9-11	27.87	130.5	71.7	66.8	55.8	67.9	19.6	20.3	15.0	14.3	74.1	8.0	8.1
9-10	27.16	130.5	70.5	64.4	57.0	66.8	19.7	20.5	12.5	13.0	74.6	8.2	7.9
9- 4	25.29	130.5	67.6	67.6	55.2	68.4	20.2	20.6	13.1	13.0	74.3	7.5	7.2
9- 3	27.22	130.2	69.7	65.1	55.7	65.1	20.2	19.3	13.6	14.3	73.4	8.0	8.0
7- 7	29.48	130.2	70.7	66.8	56.6	67.2	22.1	21.0	14.3	14.0	74.4	7.6	7.4
9- 7	26.65	130.2	65.7	65.2	56.5	66.0	19.7	20.5	14.1	13.0	73.7	8.2	6.7
9- 8	28.01	129.9	69.2	68.6	56.3	67.8	21.5	21.0	13.7	13.6	73.3	7.4	7.9
9- 4	27.33	129.5	69.5	66.2	54.9	66.8	20.0	20.5	13.8	14.1	74.8	7.4	7.5
9- 7	28.86	129.2	68.6	63.7	54.4	64.8	20.4	20.2	13.1	14.0	72.3	7.3	7.6
7-10	23.70	128.9	67.9	66.4	56.4	67.5	21.0	18.5	12.3	13.8	72.7	7.7	7.7
8- 8	26.54	128.9	64.7	63.8	56.6	66.8	19.5	20.5	14.2	13.0	72.0	8.9	8.1
9- 1	24.78	128.9	64.1	67.0	56.5	68.5	21.5	20.0	13.4	13.0	72.9	7.0	6.9
7-11	29.20	128.9	69.8	64.4	54.5	68.4	20.5	21.0	14.4	13.7	73.2	8.2	11.0
10- 7	25.46	128.6	70.5	63.9	45.9	65.9	20.2	19.0	13.0	13.0	72.2	5.9	7.4
7- 9	25.74	128.3	67.9	64.8	56.5	67.5	19.6	19.9	14.6	14.3	73.9	7.8	7.5
10- 8	30.56	128.3	71.4	63.7	51.8	63.6	19.6	21.1	14.2	14.6	71.4	7.4	7.4
9- 7	24.84	128.0	67.6	65.9	54.9	65.3	18.7	20.3	12.7	13.9	73.3	7.3	7.3
8- 7	26.20	128.0	68.6	65.5	56.6	65.8	19.5	20.0	13.7	14.0	71.7	6.7	7.0
9- 2	26.73	127.6	68.6	64.0	53.5	65.6	21.1	18.8	13.4	14.5	71.7	7.6	8.0
8- 6	25.18	127.6	67.6	64.9	54.0	66.2	18.3	18.6	13.3	14.0	72.6	8.0	7.5
8- 6	26.76	127.6	67.0	64.5	54.3	66.4	20.2	21.0	13.5	14.7	73.3	8.0	8.1
11- 0	30.22	127.0	71.1	61.5	53.3	62.4	20.5	20.9	13.6	15.0	71.9	8.4	8.2
8- 0	24.32	127.0	70.1	62.2	55.6	64.7	20.0	19.6	12.4	13.9	73.9	6.8	6.0
7- 6	25.52	127.0	67.9	64.5	53.4	65.9	20.5	20.5	13.5	13.6	72.2	6.3	7.2
11- 2	24.10	126.7	63.2	66.8	56.0	66.3	20.0	19.2	13.6	14.6	72.6	7.3	6.7
10- 2	26.73	126.4	66.6	66.1	61.2	65.9	20.0	20.2	13.8	14.2	70.6	6.6	7.1
8- 9	23.47	126.4	66.0	65.1	55.1	68.3	18.6	18.5	13.0	14.5	72.3	7.9	7.6

Table 9 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters: Transverse Pelvis	Diameters: Transverse Chest	Diameters: Anteroposterior Pelvis	Diameters: Anteroposterior Chest	Plane of gravity: From soles	Plane of gravity: From back at 25°	Plane of gravity: From back at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
7-11	25.37	126.4	66.6	65.0	54.5	66.7	21.2	21.5	13.2	13.4	73.6	7.6	7.7
11- 7	25.86	126.4	63.5	65.4	54.3	65.2	18.3	20.6	12.5	14.6	73.4	8.0	7.2
7- 6	21.90	126.2	69.0	66.8	-	65.7	-	-	-	14.0	67.6	-	-
10- 4	24.04	126.0	66.0	66.8	54.4	67.4	19.5	19.3	12.2	13.5	73.3	8.1	7.8
7- 9	27.95	125.7	68.6	62.6	52.2	62.9	19.2	19.8	13.3	15.0	70.5	7.6	7.7
8- 8	25.91	125.1	70.8	-	-	-	19.8	19.0	11.5	13.0	71.4	8.2	8.1
7- 6	24.95	125.1	67.6	64.5	56.1	63.5	21.2	21.0	12.9	13.5	72.0	6.7	7.0
7- 2	25.63	125.1	67.3	63.0	51.8	64.6	20.4	20.5	13.7	13.9	70.1	7.7	7.4
7- 5	24.44	124.8	67.3	63.4	53.0	64.1	20.5	19.5	13.5	13.5	72.1	8.4	8.0
9-10	22.11	124.2	68.4	61.5	52.0	65.0	19.5	18.1	12.0	14.0	70.3	8.4	7.9
7-10	23.36	124.1	67.9	62.4	54.5	64.4	19.2	20.0	13.3	12.9	71.0	7.9	7.7
8- 1	23.16	124.1	65.4	63.1	55.0	63.9	18.8	19.4	12.8	14.2	70.5	7.7	7.7
9- 5	23.30	123.5	67.0	62.1	59.2	62.4	20.7	20.0	12.6	12.4	69.9	8.2	7.7
8- 9	23.02	123.2	66.3	-	-	-	18.4	18.4	11.8	14.0	71.1	6.9	7.2
7- 1	22.48	123.2	66.6	62.8	52.1	63.5	20.8	18.0	12.6	14.0	70.7	7.0	7.0
7-10	24.44	122.9	61.5	61.9	52.8	62.6	19.5	18.5	13.0	14.0	69.8	7.1	7.1
7-10	20.58	122.9	61.0	63.7	53.5	66.9	18.2	20.5	12.4	12.0	70.6	7.5	7.2
8- 9	22.68	122.9	63.5	62.8	51.7	65.4	18.7	19.2	13.0	15.5	70.6	7.3	7.2
7- 0	22.85	122.9	66.0	62.8	61.1	64.7	19.3	18.0	12.3	14.5	69.9	7.3	7.5
7- 8	24.10	122.6	67.9	60.2	54.2	61.6	20.6	20.5	12.3	13.8	69.9	8.5	8.0
7- 7	22.74	122.6	69.2	61.4	54.7	62.2	19.6	20.0	12.5	14.5	70.2	7.3	7.2
8- 6	22.71	122.6	65.4	63.4	52.5	64.1	19.1	19.5	12.5	13.0	70.6	8.2	7.5
6-10	22.68	122.5	67.9	60.7	53.8	62.6	18.7	19.5	12.6	14.1	69.5	6.6	6.4
8- 1	24.44	122.2	67.0	62.8	54.2	64.6	19.5	20.2	12.6	14.0	70.7	7.8	7.5
8- 5	26.31	121.9	67.3	60.7	53.8	63.4	19.6	21.3	13.7	14.0	68.3	7.1	7.4
8- 7	21.43	121.9	62.9	60.8	51.7	63.2	19.0	18.0	12.5	12.9	69.0	7.0	7.3
8- 1	23.25	121.6	66.0	61.6	49.9	61.5	19.0	19.1	12.9	13.2	68.9	7.1	7.0
7- 1	23.59	121.3	65.4	60.1	53.0	62.8	19.0	19.6	13.1	14.2	68.9	7.3	7.3
7- 1	22.92	121.3	66.0	62.0	52.3	63.3	19.1	19.0	12.1	13.2	69.4	7.1	6.7
7- 9	22.45	121.3	65.4	60.6	53.3	61.8	19.5	19.4	12.4	12.9	70.0	7.6	7.8
7- 2	22.57	120.7	65.4	59.9	52.1	62.4	19.3	18.5	13.0	13.6	70.0	7.1	7.5
7-11	22.57	120.7	66.0	60.8	50.7	62.0	19.2	18.5	12.5	13.8	68.5	7.0	6.9
7- 5	23.30	120.7	64.7	61.1	49.8	62.5	18.5	18.6	12.6	13.3	68.9	7.5	7.3
8- 4	20.41	120.0	64.7	61.8	52.5	62.6	18.6	18.0	12.5	13.6	70.0	8.1	7.3
8- 1	25.35	119.7	67.0	57.9	57.3	60.6	19.0	20.7	13.0	13.5	69.3	8.1	7.6
7-11	22.74	119.7	67.3	59.1	49.4	60.2	18.2	18.8	12.5	13.3	68.5	7.2	7.3
7- 7	23.08	119.7	66.3	59.9	51.8	59.5	19.3	18.9	12.3	13.7	67.2	7.2	7.1
7- 5	24.44	119.7	66.0	59.2	54.4	60.0	21.0	20.6	12.9	13.2	69.2	7.9	7.5
5- 4	25.90	119.5	67.5	59.8	48.8	62.8	20.3	18.9	12.0	14.4	67.4	8.0	-
7- 8	22.62	119.4	64.1	60.9	54.0	61.9	19.5	19.0	12.4	13.0	67.2	6.4	6.6
6- 3	23.47	119.1	64.1	60.8	51.8	62.6	20.0	19.2	11.8	13.5	67.4	7.7	7.2
7- 1	20.75	119.1	65.1	58.3	47.3	61.4	18.0	19.3	12.0	12.9	68.3	7.3	8.0
8- 2	21.04	118.7	63.8	60.8	52.2	61.5	19.0	19.8	12.1	13.6	68.4	6.8	7.0
6- 9	22.68	118.4	64.1	69.1	52.6	63.7	19.0	18.5	12.7	13.7	66.1	7.3	7.9
11- 0	20.19	118.4	61.0	60.3	54.4	61.9	19.0	19.2	12.5	12.2	69.4	7.7	7.6
7- 5	19.73	118.1	63.2	60.3	50.0	61.3	18.3	18.0	12.5	12.9	67.2	7.1	7.6
6-10	20.19	117.8	63.8	58.8	49.9	59.4	18.0	18.4	13.0	11.6	66.9	7.0	7.3
7-11	20.07	117.5	63.5	59.8	49.3	59.8	18.5	18.3	12.6	13.5	68.3	8.0	7.7
7-10	21.04	117.2	65.1	57.6	50.5	59.4	17.2	19.0	12.4	13.3	66.6	7.1	7.3
6-10	21.29	117.2	63.5	57.4	50.4	59.6	18.0	18.0	13.0	13.6	66.3	7.7	7.1
6- 4	21.43	117.2	64.4	58.4	50.8	57.8	19.3	19.6	12.1	13.0	67.5	7.0	7.2
6-10	19.56	117.1	63.2	60.2	50.0	61.5	17.9	17.5	11.8	13.0	68.4	7.0	7.3
7- 3	22.40	116.9	64.1	57.0	51.9	57.6	18.3	19.0	13.7	13.1	66.2	6.6	6.9
6- 3	23.13	116.2	62.9	57.9	49.2	58.8	20.5	19.5	13.0	13.5	66.1	7.8	7.6
6- 1	20.64	116.2	60.3	57.7	50.1	60.5	18.6	18.0	11.8	13.5	66.6	7.3	7.4
6- 6	22.40	115.8	63.2	57.0	49.4	58.0	18.3	19.0	12.3	12.4	66.8	7.5	7.5
5- 8	20.25	115.6	-	-	-	-	-	-	-	-	67.6	7.0	7.2
5- 6	18.95	115.5	63.5	55.5	48.5	57.8	18.8	17.9	11.2	13.9	67.0	7.6	7.1
6- 5	22.00	115.5	63.8	56.7	50.0	57.8	19.6	19.5	12.2	12.6	66.4	7.0	7.3
6- 0	20.30	114.9	61.6	56.6	50.1	57.5	19.1	18.4	11.7	13.0	66.1	7.8	7.2
7- 1	22.00	114.6	64.1	56.9	48.1	58.8	18.3	17.8	12.5	13.5	65.0	7.2	7.3
6- 1	20.81	114.6	59.7	59.5	52.3	58.3	19.0	18.0	12.5	15.0	67.0	7.5	7.5
6- 0	20.47	114.3	69.2	56.9	49.5	59.4	17.5	18.7	11.9	12.2	67.0	8.4	7.9
5- 5	21.81	114.0	64.1	56.4	50.2	57.6	19.0	17.5	11.8	12.6	64.3	7.3	7.2
5-11	18.03	114.0	60.0	56.1	47.5	58.8	17.0	17.7	11.0	12.5	66.0	7.6	7.3
5- 4	18.97	113.7	-	-	-	-	-	-	-	-	65.6	7.4	7.2
6- 2	19.90	113.7	62.2	55.4	49.8	57.6	19.7	18.0	12.0	13.5	65.0	6.3	6.8
6- 5	18.03	113.3	64.1	54.4	45.2	55.9	17.9	17.8	11.6	12.1	65.2	6.3	6.9
5-10	21.04	113.0	63.8	55.0	47.9	54.8	18.3	18.2	12.7	13.2	65.2	7.2	7.3
6- 4	24.00	113.0	64.7	53.0	48.7	54.1	19.5	18.8	13.1	14.0	63.2	6.7	6.6
6- 3	19.73	113.0	59.7	56.7	49.8	58.5	18.0	18.1	12.0	12.8	65.0	6.5	7.0
5- 3	19.69	112.8	64.0	53.1	52.4	55.9	19.4	18.8	11.4	14.5	65.0	6.2	-
7- 0	21.09	112.7	61.6	57.1	49.5	58.2	18.0	18.5	12.5	13.6	64.9	7.2	7.0
5- 4	18.77	112.7	62.8	54.4	46.3	55.1	18.0	19.0	11.7	14.1	64.6	6.7	6.7
7- 8	18.37	112.4	60.3	-	-	-	18.5	17.6	11.6	13.3	66.3	6.6	6.7
5-11	19.96	112.4	61.6	57.3	48.4	58.1	18.0	19.1	12.0	12.4	65.5	6.9	7.2
4-11	22.84	112.3	-	-	-	-	-	-	-	-	63.5	7.7	-
5- 7	20.00	112.2	62.8	56.7	46.5	56.6	18.5	19.6	11.7	13.5	65.2	7.9	7.4
5- 1	20.17	112.1	62.3	55.9	47.6	56.8	18.4	19.0	11.5	13.6	65.0	7.4	7.2
4- 1	21.42	112.0	63.4	53.6	48.2	54.0	19.2	18.7	11.4	13.9	62.6	7.6	-

Table 9 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters: Transverse Pelvis	Diameters: Transverse Chest	Diameters: Anteroposterior Pelvis	Diameters: Anteroposterior Chest	Plane of gravity: From soles	Plane of gravity: From back at 25°	Plane of gravity: From back at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
6- 7	16.84	111.4	61.2	55.1	46.8	55.8	16.5	16.8	10.9	13.5	65.0	7.1	6.7
6- 2	16.84	111.4	60.6	53.4	50.6	55.9	17.2	18.0	11.0	11.2	65.0	7.7	6.9
5- 0	18.82	111.1	61.2	54.4	49.6	55.6	18.2	18.2	11.9	12.0	63.7	6.6	6.6
6- 1	21.49	110.5	61.9	52.9	48.5	55.8	18.4	17.2	12.0	14.0	62.4	7.2	6.7
5- 3	19.29	110.4	63.9	52.9	44.1	54.9	17.5	18.6	11.3	13.5	64.2	7.4	6.8
5- 3	20.57	110.2	-	-	-	-	-	-	-	-	63.3	7.4	-
6- 7	18.60	109.9	60.6	54.4	47.4	53.9	18.3	18.3	11.2	13.0	63.5	7.5	7.4
4- 8	20.75	109.8	63.2	52.3	49.0	53.6	18.2	18.0	11.7	13.5	62.8	8.0	7.6
6- 1	16.80	109.8	-	-	-	-	-	-	-	-	65.0	7.8	7.9
5- 0	17.80	109.6	-	-	-	-	-	-	-	-	63.3	7.7	7.0
5- 8	18.77	109.5	60.9	52.9	47.3	53.6	17.5	17.0	11.8	12.8	62.6	6.8	5.5
5- 7	16.95	109.5	60.3	54.6	46.4	54.9	17.1	17.8	11.5	11.5	63.0	6.5	6.9
4- 5	17.62	109.3	63.2	53.0	44.8	54.1	17.0	18.5	10.7	12.6	63.2	6.7	6.5
4-11	17.72	108.8	61.2	53.7	45.9	53.8	17.3	18.5	10.6	13.5	64.3	7.5	7.1
4- 1	16.60	108.8	-	-	-	-	-	-	-	-	62.0	6.9	6.6
5- 7	18.55	108.7	-	-	-	-	-	-	-	-	62.8	6.7	-
4-11	18.40	108.5	-	-	-	-	-	-	-	-	63.4	7.6	7.2
5- 6	17.07	108.4	61.8	54.3	-	54.6	-	-	-	13.7	62.3	7.2	7.0
5- 0	20.25	108.3	-	-	-	-	-	-	-	-	62.1	8.1	-
6- 0	18.37	108.2	60.6	53.3	48.8	53.6	16.9	18.0	11.6	12.0	62.8	7.3	6.8
5- 9	17.01	108.0	60.6	50.6	45.3	52.9	17.0	17.3	12.0	13.0	63.0	7.0	6.8
5- 6	17.77	107.6	59.7	52.8	48.8	52.6	16.6	18.3	11.5	12.0	62.7	6.8	6.9
5- 0	17.92	107.0	60.6	50.3	44.5	51.8	16.9	17.4	11.0	12.7	61.1	7.6	7.5
4- 4	19.56	107.0	59.3	52.8	45.5	52.5	18.4	17.5	11.0	13.8	60.9	7.2	7.3
5- 6	17.24	106.6	59.3	52.9	48.2	53.1	17.6	18.5	10.9	13.0	61.7	5.9	6.9
5- 1	20.58	106.6	59.3	53.5	45.2	53.6	18.2	18.6	11.9	13.6	60.7	7.9	7.4
5- 0	18.87	106.5	60.8	51.8	46.0	52.7	18.7	18.9	10.6	12.9	61.6	7.4	-
4- 8	16.85	106.5	60.2	51.1	45.9	52.7	16.8	17.8	10.5	13.0	62.6	8.3	7.3
5- 2	19.34	106.0	58.4	52.4	46.9	-	18.0	18.3	11.5	13.3	60.9	7.7	7.5
4-10	17.75	105.4	59.7	52.6	55.4	-	17.0	18.0	10.9	12.1	60.2	6.5	5.4
3- 8	18.26	105.4	60.9	50.1	45.0	-	17.1	17.7	11.0	15.2	60.1	6.3	6.8
5- 0	17.55	105.2	60.0	53.1	44.3	53.6	16.6	17.8	11.0	13.6	62.0	7.3	7.3
5- 7	15.87	105.1	-	-	-	-	-	-	-	-	61.8	7.2	6.9
5- 0	16.84	104.8	58.7	52.1	45.5	51.9	18.3	17.3	11.1	12.0	60.2	6.0	6.4
5- 0	16.33	104.8	58.4	51.8	46.2	54.4	17.0	17.5	11.4	12.5	62.5	7.5	7.1
4- 6	18.60	104.8	59.7	51.2	44.2	50.6	18.5	17.5	11.2	12.5	59.7	6.5	6.5
4- 1	17.97	104.6	61.4	49.2	-	52.9	-	-	-	14.0	60.1	7.3	6.8
4- 6	15.07	104.5	60.5	51.4	41.9	51.6	17.5	16.2	9.0	13.4	61.5	6.6	7.0
4- 9	15.59	104.1	58.4	50.2	45.5	52.3	16.7	17.5	11.3	13.0	61.1	6.6	6.4
4- 0	16.78	103.8	61.2	48.9	42.5	40.5	15.6	17.0	10.9	12.4	59.4	6.8	6.7
4-11	17.55	103.7	-	-	-	-	-	-	-	-	61.1	7.8	7.3
5- 8	17.12	103.5	58.4	50.1	43.5	50.9	16.2	17.3	11.1	13.2	59.9	6.3	6.5
4- 7	18.07	103.5	58.4	50.6	46.1	51.9	16.0	17.0	11.0	12.6	59.5	7.2	6.8
4- 9	17.07	103.5	58.6	51.0	43.7	52.6	16.6	17.4	10.9	13.5	60.4	7.8	7.1
5- 9	16.85	103.4	58.9	49.9	42.5	50.8	17.1	18.4	9.8	12.3	60.5	7.1	6.9
4- 1	18.40	103.4	61.7	47.7	39.7	51.1	17.3	17.8	9.8	12.2	59.0	6.9	-
4- 3	17.35	103.3	57.6	49.3	46.0	51.6	17.4	18.8	11.5	12.2	60.1	7.0	6.7
4- 9	15.45	103.0	59.9	49.3	42.6	50.1	16.0	17.7	10.2	13.4	60.8	6.4	6.3
5-11	18.02	103.0	62.4	49.9	-	52.2	-	-	-	13.5	59.2	6.7	6.6
4- 7	15.71	102.9	58.4	48.5	41.5	49.5	15.0	17.0	10.7	12.6	59.7	7.1	6.5
4- 7	15.99	102.9	60.3	49.4	44.2	49.9	16.2	15.0	10.7	12.0	58.6	7.0	6.6
5- 0	18.88	102.6	60.3	47.5	43.0	48.9	17.2	18.7	11.4	13.6	58.8	7.3	7.0
4- 0	17.61	102.4	60.1	48.6	41.0	48.9	17.1	17.3	10.6	14.2	58.9	6.8	6.6
5- 1	15.88	102.2	57.4	49.0	44.2	51.0	16.4	18.0	10.5	13.6	60.0	7.2	6.8
4- 3	17.85	102.2	59.2	47.9	42.3	50.0	16.8	18.8	10.6	13.0	59.5	8.6	7.7
5- 2	15.95	102.1	-	-	-	-	-	-	-	-	59.7	7.4	6.9
4-11	16.90	101.9	59.3	47.5	43.1	49.3	16.9	17.7	11.0	12.9	59.9	7.8	7.4
4-11	16.33	101.9	60.0	46.7	43.1	48.5	16.5	17.6	11.0	12.5	57.8	5.8	6.8
4- 4	16.05	101.6	57.1	49.9	45.6	50.1	17.3	17.0	11.0	12.0	60.0	6.6	7.0
4- 5	15.40	101.3	59.9	46.6	44.1	48.6	16.2	17.0	10.2	12.8	59.5	6.6	6.4
3- 9	16.50	101.2	57.9	47.8	42.0	48.6	17.6	17.9	10.4	13.5	58.1	7.7	7.8
5- 2	16.42	101.0	59.2	51.1	-	49.4	-	-	-	13.5	59.7	7.7	7.5
3-10	14.22	100.9	56.2	48.9	43.2	49.6	16.3	17.3	10.2	12.4	59.0	6.2	7.1
4- 2	16.01	100.7	-	-	-	-	-	-	-	-	57.8	6.4	6.4
5- 8	15.10	100.6	57.4	49.2	42.5	48.6	17.8	17.8	9.3	12.1	59.5	7.7	5.1
4-11	16.10	100.3	57.8	47.1	42.6	48.2	17.0	18.0	10.8	12.6	58.4	6.2	6.7
5- 8	17.05	100.0	-	-	-	-	-	-	-	-	56.9	6.6	6.4
3-11	15.99	100.0	61.3	49.5	-	50.9	-	-	-	13.5	59.9	7.7	7.4
4- 7	15.48	99.4	55.9	48.4	44.0	48.8	16.1	17.5	10.2	12.2	57.7	6.1	6.0
4- 2	14.89	99.2	-	-	-	-	-	-	-	-	58.1	6.1	6.4
3- 4	16.10	99.2	59.4	46.2	41.1	46.1	16.2	17.8	9.9	12.3	57.3	-	6.7
5- 6	14.84	99.1	55.5	48.5	42.6	49.5	17.5	17.5	10.2	12.6	57.0	7.1	8.9
4- 5	16.10	98.7	57.4	46.5	43.9	47.8	16.8	18.0	11.1	12.4	57.3	7.1	7.0
3- 7	14.00	98.3	56.3	47.2	37.8	48.4	16.1	17.2	10.0	12.6	57.7	6.9	6.5
3- 8	17.48	98.2	59.3	45.7	41.1	45.8	17.1	17.8	10.7	13.7	56.4	7.3	7.0
3- 8	14.30	98.1	58.4	46.1	41.8	48.9	15.8	17.4	10.4	12.9	56.2	8.9	9.5
3- 5	14.97	97.4	56.0	45.8	41.5	47.1	17.1	18.2	9.3	11.9	57.5	5.7	8.0
3- 7	13.32	97.3	-	-	-	-	-	-	-	-	57.4	6.7	6.2
2- 9	13.90	97.2	55.8	45.6	40.5	48.4	16.8	17.2	10.0	12.3	56.8	6.8	6.3
4- 5	15.88	97.1	57.1	45.7	38.2	45.3	17.0	17.0	10.7	12.4	55.5	6.5	7.1

Table 9 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters				Plane of gravity		
							Transverse		Anteroposterior		From soles	From back	
							Pelvis	Chest	Pelvis	Chest		at 25°	at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
3- 9	15.57	96.9	55.8	48.2	41.5	50.9	16.0	17.4	10.7	13.0	57.6	7.5	7.0
3-10	14.00	96.4	-	-	-	-	-	-	-	-	56.7	6.0	6.1
2-10	15.65	96.1	-	-	-	-	-	-	-	-	56.2	7.5	6.7
3- 6	16.00	96.0	57.2	44.1	40.2	47.1	16.0	17.8	10.4	13.3	56.0	8.1	7.3
2-11	15.00	95.8	57.9	44.6	38.2	47.0	17.2	18.3	9.9	13.3	56.2	6.7	6.4
3- 4	15.76	95.5	58.1	42.4	41.2	43.9	16.4	17.2	9.9	12.2	54.6	6.1	6.4
3- 7	15.93	93.9	54.5	45.9	41.9	-	16.0	18.5	-	13.8	54.7	6.6	7.5
3- 3	13.42	93.5	56.4	43.0	38.9	44.3	14.4	17.6	9.4	13.4	53.7	6.4	6.2
2-11	11.17	93.3	53.6	42.0	37.8	43.6	15.7	18.7	9.8	12.2	---	-	-
3- 2	13.15	93.2	54.3	44.3	39.3	44.3	14.5	16.9	9.4	13.3	54.9	6.7	6.8
3- 2	14.80	92.8	-	-	-	-	-	-	-	-	54.2	6.6	6.2
3- 0	14.52	92.7	52.3	-	-	-	15.4	16.0	10.2	12.8	53.2	5.3	7.0
2- 8	14.85	92.5	-	-	-	-	-	-	-	-	52.3	10.5	10.1
2- 6	16.62	92.2	56.6	39.6	38.9	40.3	16.4	16.5	10.2	11.9	53.2	7.1	6.3
2- 4	12.85	92.1	-	-	-	-	-	-	-	-	55.7	-	-
3- 5	11.95	91.8	56.7	42.8	-	44.9	-	-	-	12.4	54.2	6.7	6.2
2- 5	13.40	91.5	53.0	42.9	39.0	44.5	15.5	16.9	8.9	12.6	53.4	7.3	-
3- 3	14.40	91.1	54.3	-	-	-	-	-	-	-	52.4	6.4	6.8
2- 6	14.87	91.1	54.8	42.1	37.7	44.2	14.4	16.3	9.8	13.5	52.7	6.2	-
2-11	14.29	91.0	53.7	41.6	36.6	40.5	15.8	16.7	9.6	13.4	52.5	6.7	-
2- 3	14.55	90.0	54.2	42.6	35.9	43.4	14.0	16.3	9.5	13.2	51.0	5.9	6.0
1-11	14.15	90.0	-	-	-	-	-	-	-	-	51.4	-	-
2- 7	12.90	88.4	56.5	41.1	-	41.5	-	-	-	13.3	50.9	7.0	-
2- 8	13.69	88.2	52.7	-	-	-	-	-	-	-	50.7	7.0	-
1-10	13.21	87.6	-	-	-	-	-	-	-	-	47.7	6.5	-
2- 7	11.82	87.0	-	-	-	-	-	-	-	-	51.6	6.6	6.5
2- 7	14.40	85.4	-	-	-	-	-	-	-	-	46.6	9.1	-
1-11	10.93	84.5	-	-	-	-	-	-	-	-	47.7	-	-
2- 4	12.13	83.5	-	-	-	-	-	-	-	-	46.2	2.3	-
2- 1	13.15	81.5	-	-	-	-	-	-	-	-	47.5	9.7	-
1- 7	11.75	-	54.0	-	-	-	-	-	-	-	47.9	10.3	-
1- 7	11.32	-	53.8	34.9	-	36.4	-	-	-	12.5	45.4	6.5	-
0-10	11.30	-	51.4	-	34.0	35.2	12.4	15.2	8.7	10.8	43.6	8.0	-
1- 7	11.27	77.0	52.0	34.5	-	34.0	-	-	-	12.2	45.3	8.2	-
1- 2	10.89	-	-	33.8	33.3	32.8	-	-	-	-	44.0	8.1	13.1
1- 0	10.95	-	51.0	32.8	-	32.2	-	-	-	11.7	44.3	7.2	-
0-10	9.38	-	46.1	-	32.9	33.9	12.2	14.0	8.9	10.9	44.5	-	-
1- 1	7.75	-	48.4	30.3	-	32.6	-	-	-	11.5	44.5	-	-
0-10	8.80	-	47.4	-	33.0	33.0	12.3	13.5	8.0	10.6	42.4	-	-
1- 0	8.68	-	-	-	-	-	-	-	-	-	42.4	8.0	-
0-10	10.00	-	45.6	-	31.6	33.8	12.2	14.8	8.9	11.5	38.8	5.6	-
0- 9	8.05	-	46.3	30.1	-	31.4	-	-	-	10.6	41.0	7.6	
0- [illegible]	8.20	-	-	-	-	-	-	-	-	-	40.2	-	9.7
0-11	6.46	-	44.5	27.3	-	27.2	-	-	-	10.2	39.9	6.0	-
0- 7	6.30	-	43.4	26.7	-	-	-	-	-	10.2	39.5	8.7	-
0- 3	6.88	-	43.5	26.4	-	27.6	-	-	-	10.2	37.0	7.3	-
0- 3	6.05	-	42.4	25.8	-	25.0	-	-	-	11.0	37.5	8.1	7.1
0- 1	4.91	-	41.3	23.9	-	24.5	-	-	-	10.2	35.2	6.8	-
0- 2	5.70	-	40.7	24.1	-	23.9	-	-	-	11.0	33.7	6.8	-
0- 4	5.37	-	43.0	25.6	-	21.0	-	-	-	11.0	34.8	4.9	-
0- 1	4.00	-	37.8	21.7	-	22.4	-	-	-	9.9	33.4	6.7	-
0- 2	4.71	-	38.6	20.4	-	21.0	-	-	-	9.6	-	-	-
0- 2	3.60	-	37.0	23.5	-	21.0	-	-	-	10.5	32.6	7.2	-
0- 1	4.90	-	38.3	22.0	-	23.0	-	-	-	11.2	32.6	9.7	-
0- 1	3.79	-	36.0	22.1	-	22.9	-	-	-	9.9	32.7	7.8	-
0- 2	3.95	-	36.4	21.2	-	22.0	-	-	-	9.6	33.7	-	-

Table 10

Observations upon the transverse and frontal planes of gravity, age, weight, stature, pubic and sitting heights, arm and leg lengths and anteroposterior and transverse diameters of the pelvis and chest for living subjects

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters				Plane of gravity		
							Transverse		Anteroposterior		From soles	From back	
							Pelvis	Chest	Pelvis	Chest		at 25°	at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
12- 2	64.73	176.2	90.1	98.4	80.4	97.7	26.0	24.0	18.8	17.0	100.7	10.3	10.1
19- 2	57.13	175.9	91.4	-	-	-	26.7	24.0	17.0	15.6	98.3	9.0	9.2
18- 8	54.41	175.3	92.4	-	-	-	29.0	24.0	17.5	17.5	98.6	9.2	9.5
17- 5	60.02	174.3	90.5	94.9	80.0	95.9	26.3	23.0	17.4	13.8	100.5	9.7	10.0
13-11	49.53	174.0	90.1	94.0	77.1	92.7	26.5	24.2	16.6	14.5	101.0	9.5	9.5
15-11	62.29	173.0	90.5	91.7	77.6	92.4	29.0	25.3	18.4	15.2	96.1	9.6	9.8
14-11	47.72	173.0	90.1	-	-	-	27.0	22.6	15.2	13.0	96.2	8.6	8.4
17- 4	55.26	170.2	87.3	90.7	75.2	-	28.5	24.6	16.8	16.3	95.2	9.8	9.7
17- 2	52.37	170.2	91.1	-	-	-	25.6	24.0	16.6	16.0	93.7	9.3	9.4
17- 8	52.65	169.9	87.6	-	-	-	28.0	26.5	18.2	15.0	94.6	8.2	8.5
13- 9	60.19	169.5	87.3	92.6	76.9	91.3	26.4	23.7	18.2	18.8	95.6	10.3	10.0
15- 0	57.47	169.2	88.6	90.7	72.1	87.9	28.0	23.0	16.9	17.0	94.3	8.8	9.2
16- 1	54.75	168.9	87.3	90.5	77.2	91.9	27.5	24.0	19.0	16.0	96.2	8.7	8.9
16- 2	52.71	168.6	89.5	88.7	74.8	89.0	26.7	25.3	16.5	15.0	95.0	8.9	9.2
16- 1	62.18	168.6	91.4	-	-	-	27.6	26.0	16.4	16.2	93.0	8.8	9.3
14- 3	61.61	168.2	86.0	-	-	-	26.5	24.0	18.6	16.0	94.5	9.6	9.9
16- 2	58.72	168.2	91.1	-	-	-	27.0	23.0	17.3	17.0	91.9	9.3	9.3
17- 1	71.25	168.8	89.8	87.2	72.8	-	28.0	28.5	19.6	19.6	94.0	10.6	10.5
17- 0	49.02	167.6	83.2	89.7	76.0	-	26.5	22.2	17.4	15.0	94.7	8.1	8.1
15- 3	63.14	167.6	87.6	-	-	-	25.6	24.0	16.8	16.6	94.7	9.3	9.7
16- 6	63.08	167.3	85.7	-	-	-	28.8	24.3	19.4	16.0	91.5	8.8	9.0
13- 8	57.87	167.0	88.2	87.5	74.8	89.7	27.0	26.7	17.5	18.1	94.4	10.0	10.0
12- 8	55.71	166.4	87.0	88.7	75.6	88.7	25.6	25.0	17.4	14.3	94.3	9.1	9.3
15-11	52.48	166.4	87.6	89.9	73.0	88.5	26.7	24.0	17.0	15.3	93.3	8.0	9.4
17- 7	62.01	166.1	88.6	-	-	-	27.7	23.0	16.8	16.6	93.1	7.4	6.5
13- 8	50.34	165.7	89.8	87.3	71.9	85.7	24.5	22.5	17.6	16.4	92.2	8.7	8.9
15-10	48.06	165.7	89.5	85.6	71.8	85.3	25.6	23.0	16.4	15.3	91.7	8.6	8.5
17- 3	56.00	164.9	87.9	-	-	-	26.4	25.6	18.5	17.0	93.0	9.7	9.8
18- 2	53.67	164.8	85.7	-	-	-	25.9	22.2	17.0	17.0	92.1	8.5	8.6
14- 1	48.29	164.1	88.2	82.5	70.7	82.5	26.6	23.0	17.2	14.6	90.1	9.1	9.4
14- 0	66.26	164.1	86.3	89.2	70.4	86.7	28.6	25.5	19.2	16.3	91.2	10.3	10.1
17-11	55.32	164.1	86.3	-	-	-	28.0	23.0	17.8	15.5	91.4	8.5	8.7
14- 7	54.86	163.8	83.8	-	-	-	28.2	23.7	17.4	15.3	90.5	8.9	8.9
12-11	42.16	163.8	86.3	86.2	70.8	85.1	24.5	22.7	15.2	12.3	92.1	9.0	9.0
17- 3	46.36	163.8	85.1	85.7	69.5	86.7	25.5	22.0	15.8	16.6	92.3	8.1	8.8
17- 3	50.61	163.5	85.7	85.3	71.8	85.5	26.0	24.0	17.1	14.2	90.7	8.7	8.8
16- 8	52.20	163.5	84.4	-	-	-	24.0	23.5	17.0	15.5	92.0	8.8	8.9
16- 3	51.01	163.5	84.4	-	-	-	27.0	22.0	16.4	15.5	93.0	7.8	8.3
16- 3	55.77	163.2	88.2	86.0	73.2	-	24.6	24.0	17.5	16.0	90.8	9.2	9.5
14- 0	51.46	162.9	84.7	85.7	70.6	86.0	26.0	23.0	17.5	15.5	91.7	8.8	8.7
15-11	47.55	162.9	84.4	-	-	-	27.2	22.7	16.8	14.2	90.5	7.8	8.1
13- 5	43.75	162.9	84.7	85.0	73.6	85.7	25.8	22.0	16.0	14.5	90.5	7.9	8.2
13- 6	46.24	162.6	84.7	86.4	75.1	86.4	27.0	25.4	15.0	14.0	92.6	8.3	8.4
14- 8	54.30	162.6	82.2	88.0	64.0	88.1	25.0	24.0	17.6	16.0	92.4	9.1	9.1
17-11	50.38	162.6	81.9	-	-	-	27.4	22.0	18.0	14.6	91.0	8.5	8.5
14-11	49.87	162.6	82.2	88.6	74.5	88.7	27.0	25.5	16.7	14.7	92.3	8.0	8.8
14-11	47.27	162.6	86.3	-	73.6	84.7	25.5	22.0	16.5	15.0	91.4	8.7	9.2
15-10	53.79	162.2	85.7	85.5	73.1	85.6	25.7	22.6	17.2	15.0	89.2	8.8	9.4
14- 2	52.59	162.2	83.2	87.2	70.3	86.7	26.3	23.0	16.4	15.2	89.8	8.9	9.0
16- 8	47.44	162.2	85.1	-	-	-	23.2	21.3	16.2	14.0	89.7	8.2	8.3
14-11	48.40	162.2	85.7	87.7	70.9	85.3	25.8	22.7	17.0	16.2	90.7	9.1	9.2
15- 0	55.71	161.9	85.1	84.7	71.0	84.0	27.3	23.2	17.2	16.6	89.4	9.3	9.4
15- 0	50.89	161.9	83.5	86.1	70.7	86.0	25.0	24.0	17.6	16.2	89.8	9.0	9.1
17- 7	56.90	161.9	84.7	-	-	-	27.1	22.0	17.6	15.0	89.6	8.6	9.0
17- 4	49.31	161.9	86.0	-	-	-	27.0	23.2	16.7	14.5	89.9	9.1	9.0
13- 8	45.32	161.9	83.2	89.6	70.1	87.9	24.0	21.2	16.2	14.2	92.1	9.4	9.2
15-10	52.77	161.6	84.1	85.1	70.8	-	25.0	23.3	17.1	15.0	89.8	9.6	9.4
14- 9	54.07	161.6	82.2	86.7	70.9	87.1	26.3	24.3	17.4	16.0	91.7	9.4	9.5
17- 8	55.83	161.3	84.1	88.2	73.2	88.0	27.5	23.7	18.0	15.0	89.8	9.2	9.6
17- 4	63.14	161.3	86.0	-	-	-	27.5	28.3	18.2	16.3	89.3	10.3	10.5
14- 7	46.07	161.3	86.3	83.0	70.2	82.3	24.0	22.7	15.7	14.8	89.3	8.4	9.0
19-10	56.34	161.3	84.1	-	-	-	27.0	22.6	17.7	15.5	89.3	9.9	10.0
14- 6	47.61	161.0	83.2	86.3	73.7	85.9	24.0	23.6	16.3	15.5	90.9	8.5	8.8
16- 7	55.20	161.0	87.3	-	-	-	28.0	23.7	17.7	15.3	88.8	9.2	9.3
14- 4	50.72	161.0	82.8	87.2	71.1	84.5	24.0	22.0	17.5	16.6	90.7	8.5	8.5
14- 5	57.36	160.7	84.1	83.7	70.2	-	25.5	23.2	18.5	18.0	89.6	9.8	10.0
13- 0	41.20	160.7	82.2	-	-	-	22.7	22.5	17.0	14.7	89.6	7.9	8.1
15- 7	53.39	160.7	86.6	82.3	68.9	-	27.0	22.5	17.0	14.7	89.6	10.0	9.9
16- 1	49.14	160.7	85.1	82.7	73.0	84.5	26.0	22.3	16.8	15.6	91.0	8.7	8.7
15- 0	58.72	160.7	85.1	85.9	72.6	-	27.0	25.2	17.2	17.5	90.3	9.4	9.8

Table 10 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters				Plane of gravity		
							Transverse		Anteroposterior		From soles	From back	
							Pelvis	Chest	Pelvis	Chest		at 25°	at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
14- 9	46.98	160.7	82.2	86.7	70.7	86.3	25.3	24.0	16.2	16.0	92.4	8.6	9.3
14- 8	53.62	160.7	84.4	85.9	72.0	85.9	26.5	23.0	17.8	16.0	89.6	9.0	9.1
12- 9	54.86	160.3	81.3	87.5	71.9	88.7	23.5	23.0	-	16.5	92.6	9.9	9.8
13- 9	58.09	160.3	82.8	85.0	70.7	83.5	26.7	25.0	18.2	15.6	89.9	8.9	9.2
17- 0	55.37	160.3	83.2	82.3	66.2	83.1	26.6	23.2	16.9	16.6	89.4	9.4	9.7
16-11	43.30	160.3	87.3	-	-	-	25.2	21.7	16.2	14.4	89.8	8.8	8.8
14- 1	47.04	160.0	80.9	88.4	72.3	87.5	27.0	26.0	17.6	14.0	91.3	8.5	8.8
14-10	50.33	160.0	85.7	84.8	69.8	83.7	27.0	24.0	15.9	15.6	89.6	8.9	8.6
15- 2	50.67	160.0	80.6	87.3	72.6	-	25.4	23.0	16.9	15.8	89.3	8.7	8.6
16-10	51.53	160.0	81.3	84.2	71.5	84.5	26.2	23.5	16.8	14.5	88.3	9.9	9.4
15- 5	49.59	160.0	85.1	83.9	68.2	84.7	26.6	23.0	17.8	15.6	88.1	8.8	8.9
17-11	54.75	160.0	84.7	-	-	-	26.4	24.3	16.4	14.2	87.4	9.1	9.3
13- 7	48.51	160.0	82.5	84.3	68.7	85.1	24.2	24.0	16.0	14.0	88.6	8.0	8.5
13- 7	49.70	160.0	82.2	87.0	71.0	86.5	26.0	22.0	17.1	15.5	89.4	8.8	8.9
15- 8	43.75	159.7	-	83.2	69.6	83.7	25.5	21.6	15.5	14.2	91.9	8.4	8.4
17- 1	48.00	159.7	83.8	-	-	-	27.0	23.5	16.0	15.2	88.4	8.5	8.3
15- 4	48.46	159.7	86.0	81.0	69.0	81.0	26.5	25.0	15.1	14.0	87.5	8.8	8.6
13-10	49.53	159.4	85.1	84.6	69.2	84.2	24.4	23.2	16.6	15.0	89.5	8.7	8.5
19- 2	60.36	159.4	84.7	-	-	-	29.9	24.0	18.2	17.0	89.6	10.4	10.3
13- 6	41.08	159.4	80.3	-	-	-	20.6	22.2	15.0	14.2	90.1	8.7	8.5
16- 2	56.79	159.4	83.8	85.9	72.8	85.3	25.7	25.0	16.8	15.7	89.8	9.4	10.0
14- 0	44.88	159.4	85.4	82.9	70.1	-	25.0	21.6	16.5	14.2	88.2	8.3	8.9
16- 4	53.84	159.4	88.9	82.1	66.4	-	26.0	25.0	17.5	17.0	90.3	9.6	9.8
16- 4	47.21	159.4	84.4	81.4	67.6	83.0	26.7	22.0	15.3	15.3	87.7	8.7	8.5
13-10	47.89	159.1	82.2	85.9	72.7	85.6	23.8	23.0	17.0	14.2	89.0	8.5	8.9
16- 2	44.49	159.1	83.8	81.7	70.8	84.2	24.6	21.5	16.5	15.5	88.2	7.8	8.2
15- 4	44.32	159.1	80.3	86.7	71.7	86.4	25.0	22.7	15.9	15.0	89.7	8.7	8.6
18- 9	47.95	158.8	87.3	-	-	-	26.0	22.6	16.0	14.1	90.4	8.6	9.0
17- 0	58.55	158.8	86.6	-	-	-	26.6	25.9	17.1	16.0	86.9	9.1	9.2
15- 4	44.54	158.8	80.3	86.8	70.1	87.6	26.0	23.0	16.7	14.5	90.1	7.9	8.2
14- 8	59.63	158.8	85.7	83.2	69.6	82.4	26.8	24.7	17.8	15.5	88.3	10.8	11.4
14- 2	38.76	158.8	83.5	83.3	68.7	81.7	23.5	21.6	15.8	14.2	88.1	7.6	7.6
13- 7	38.42	158.8	79.0	88.0	69.3	86.7	25.5	23.2	16.0	14.3	90.0	8.2	8.6
16- 0	52.25	158.4	84.7	83.2	71.7	82.3	25.0	24.0	16.3	16.0	88.8	8.7	9.0
14- 3	48.00	158.4	80.9	86.7	72.0	85.3	24.0	23.5	16.2	15.3	89.5	9.4	9.1
16- 8	41.71	158.4	83.5	-	-	-	27.1	23.0	15.5	13.7	88.4	8.3	7.8
14- 4	45.00	158.4	83.8	81.7	70.0	82.4	26.0	23.7	15.7	15.0	88.4	8.3	8.6
15- 0	45.51	158.4	82.2	83.9	70.4	83.7	24.5	22.0	16.5	16.0	89.6	9.1	9.1
15- 5	47.95	158.4	81.7	84.7	69.8	84.1	27.2	24.6	17.2	15.5	88.8	8.9	8.6
16- 5	50.38	158.4	86.3	80.7	69.2	81.7	25.7	23.0	16.0	14.7	89.0	9.7	9.4
17- 4	63.14	158.4	78.2	-	-	-	27.7	24.2	17.7	15.4	88.6	9.1	9.4
16- 5	50.44	158.1	83.2	81.8	67.4	81.3	24.3	24.3	16.7	14.8	86.9	9.5	9.2
14-10	44.83	158.1	79.7	85.6	70.3	86.1	24.0	23.7	15.7	14.3	90.4	8.1	8.7
13- 3	47.66	158.1	79.3	85.7	69.9	85.2	24.5	22.8	17.8	14.0	89.2	8.9	7.8
12- 8	49.53	158.1	83.2	81.8	69.1	80.8	25.5	23.4	17.2	16.0	87.3	9.9	9.6
13- 5	44.83	158.1	82.8	84.3	71.5	83.0	24.7	22.0	16.1	15.0	87.9	-	8.0
14- 1	48.74	158.1	87.0	81.5	68.5	-	24.5	24.0	16.9	14.3	86.7	8.3	8.2
14-10	48.06	157.8	84.4	82.4	69.0	81.5	23.6	21.9	16.4	16.0	86.5	8.9	9.0
13- 8	45.90	157.8	83.2	84.2	65.7	83.8	23.3	23.3	16.5	15.2	88.2	7.6	7.9
17- 0	42.45	157.8	82.2	-	-	-	24.5	23.2	15.7	13.2	89.1	8.4	8.4
14- 5	48.40	157.8	83.5	-	-	-	25.5	25.5	17.0	14.0	88.7	9.1	9.4
17- 7	46.19	157.5	82.2	-	-	-	26.0	22.6	15.7	16.0	90.0	8.3	8.5
16- r	46.75	157.5	82.2	82.7	72.1	81.7	28.5	26.4	16.2	13.0	88.3	8.4	9.0
15-11	45.90	157.5	85.4	80.7	68.2	82.3	25.5	23.3	15.5	15.8	88.5	8.7	9.1
15- 4	43.98	157.5	82.5	79.2	68.3	-	26.0	22.3	17.0	13.5	86.6	7.7	8.2
18-11	43.75	157.5	81.9	84.9	70.2	83.1	24.5	22.0	16.2	16.6	88.2	8.0	8.5
13- 4	44.32	157.2	82.8	83.0	69.6	82.8	24.5	23.2	15.3	16.2	88.7	8.8	9.3
14- 8	46.64	157.2	80.0	83.3	66.6	82.6	26.0	21.6	17.5	15.2	87.7	8.1	8.4
15- 8	58.04	157.2	84.7	81.0	77.7	-	24.0	24.1	17.6	16.0	86.6	9.5	9.6
14- 5	52.82	157.2	83.2	83.3	68.6	83.7	25.5	24.0	18.0	15.5	88.9	9.8	9.8
14- 5	38.53	156.5	82.5	80.5	67.0	80.0	25.5	24.0	14.8	13.6	88.8	8.0	8.5
16- 3	46.87	156.5	80.3	-	-	-	27.0	23.5	16.0	14.4	89.9	8.3	8.5
13- 5	50.33	156.5	82.2	-	-	-	23.5	21.6	15.5	14.8	87.9	8.6	8.7
13- 0	43.24	156.5	81.3	-	-	-	23.0	22.5	14.6	14.3	88.1	8.5	8.3
16- 8	46.92	156.2	82.5	81.9	66.9	81.7	25.0	23.0	15.5	15.0	87.9	8.4	8.5
13- 5	51.63	156.2	86.3	79.1	68.3	-	25.8	22.0	16.8	16.8	87.9	9.3	9.5
14- 5	55.15	156.2	83.8	83.5	78.4	82.9	25.4	25.0	17.8	16.0	86.5	9.6	9.5
13- 9	44.43	156.2	80.0	-	-	-	23.5	23.0	15.5	14.3	87.4	9.4	9.3
14-11	42.22	156.2	78.1	86.1	70.6	85.9	25.3	22.0	15.6	13.5	88.7	8.2	8.4
13- 3	45.56	156.2	81.9	83.2	69.0	81.1	24.0	24.0	16.0	15.2	87.7	8.7	9.0
14- 8	48.57	155.9	-	80.5	68.9	80.3	25.0	22.5	17.6	16.5	87.5	9.3	9.3
14- 2	47.04	155.9	81.9	81.3	69.5	83.1	25.0	22.0	16.2	16.2	88.3	8.3	8.7
14- 0	45.00	155.9	80.6	-	-	-	25.7	22.0	15.4	16.2	88.5	7.7	8.0
18- 9	44.60	155.9	80.6	85.4	69.8	84.9	24.6	22.5	16.8	16.2	88.7	8.4	8.9
13- 0	43.38	155.9	80.6	84.7	68.5	83.3	23.9	24.0	16.6	15.9	89.1	8.1	8.3
15- 5	51.57	155.6	83.8	80.2	68.3	80.3	27.0	24.0	16.1	16.0	86.5	9.3	9.2
11- 4	43.47	155.6	80.6	84.0	67.4	83.0	23.7	23.5	16.6	14.8	87.9	8.3	8.5
15- 2	52.94	155.6	85.1	89.9	69.7	-	26.5	24.3	16.7	15.0	86.8	10.0	9.9
15-11	43.92	155.6	83.2	-	-	-	27.9	22.0	15.0	15.0	88.1	8.2	8.3
16- 0	45.17	155.6	82.2	-	-	-	26.0	22.1	15.7	13.7	89.2	7.7	8.1

Table 10 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters: Transverse Pelvis	Diameters: Transverse Chest	Diameters: Anteroposterior Pelvis	Diameters: Anteroposterior Chest	Plane of gravity: From soles	Plane of gravity: From back at 25°	Plane of gravity: From back at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
13- 1	45.34	155.6	81.3	83.3	70.6	83.7	22.5	21.5	16.7	15.0	86.3	8.8	8.9
13- 3	44.49	155.3	86.3	77.9	66.3	-	26.0	22.5	16.3	14.2	85.5	8.2	8.5
13- 7	49.65	155.3	81.3	82.0	68.6	81.7	25.0	23.0	17.2	15.3	86.4	9.5	9.5
11- 6	44.34	155.3	82.8	81.6	67.4	81.0	24.0	22.5	17.0	15.0	86.6	8.5	8.6
15- 1	38.82	154.9	80.0	82.9	67.2	81.9	23.6	20.5	15.4	14.6	87.8	8.0	8.5
13- 7	43.55	154.9	79.3	82.9	67.7	80.9	23.6	22.1	15.5	15.2	87.9	8.3	8.4
15- 1	48.74	154.9	84.1	78.9	67.3	79.9	26.0	23.4	15.7	16.0	86.4	8.7	8.9
13- 5	54.41	154.9	83.2	81.4	67.2	-	26.0	25.5	16.5	18.0	87.9	9.2	9.1
14- 2	40.74	154.9	83.2	80.3	66.2	79.5	25.0	21.5	15.7	14.0	85.6	8.0	8.4
14- 6	47.35	154.6	82.5	80.9	64.7	81.8	24.5	23.1	15.8	15.2	86.7	7.9	8.5
17- 7	43.30	154.6	86.0	-	-	-	26.3	23.1	15.2	14.0	85.3	7.7	8.2
13- 1	39.50	154.6	83.2	80.7	66.7	79.7	24.8	23.0	14.6	14.0	87.4	8.2	7.9
12- 1	38.65	154.3	77.8	84.4	70.0	85.9	22.6	22.2	15.0	13.2	87.1	8.0	7.7
10- 8	43.02	154.3	78.1	84.7	68.4	83.9	25.3	23.0	17.4	15.5	89.0	9.1	9.2
15- 3	48.17	154.3	85.1	-	-	-	24.2	22.5	15.6	16.2	83.9	8.5	8.3
13- 7	43.98	154.3	80.6	82.3	64.1	80.3	25.0	21.6	16.3	17.0	85.9	8.3	9.0
16- 4	48.17	154.0	82.8	77.1	65.5	77.1	24.0	24.2	17.3	15.4	85.8	9.0	8.8
15- 2	47.66	154.0	80.0	83.6	65.3	82.0	24.4	22.0	16.9	14.4	84.4	9.0	9.2
14- 6	36.72	154.0	81.6	80.0	67.0	79.1	20.5	20.5	15.0	14.7	86.8	8.2	8.0
15- 1	53.67	154.0	81.3	79.7	67.0	-	26.5	26.0	16.6	15.5	85.3	8.8	9.0
12- 0	35.58	154.0	80.0	80.5	67.2	81.9	21.3	20.6	14.4	13.0	86.7	8.0	8.5
11-10	35.81	154.0	79.3	82.6	65.2	81.7	23.6	20.0	14.3	13.3	86.7	7.9	7.8
14- 4	48.17	153.7	81.6	78.9	67.2	79.5	25.7	22.5	16.5	14.5	85.9	9.4	8.9
15- 2	47.27	153.7	81.9	81.0	67.3	78.8	24.3	23.5	15.9	14.5	84.7	8.7	8.6
12- 2	40.86	153.7	79.0	-	-	-	26.5	21.5	15.0	15.3	87.2	7.9	8.3
13- 0	46.47	153.6	83.8	78.6	67.3	77.7	24.5	23.3	17.0	16.1	85.2	8.9	8.5
15- 4	46.24	153.4	81.6	-	-	-	25.8	23.6	15.9	15.0	84.9	8.0	9.2
12- 6	45.70	153.0	77.8	83.8	68.6	83.3	24.0	22.0	17.3	17.0	86.8	8.5	8.6
12- 0	37.51	153.0	75.5	84.1	68.4	83.3	23.9	21.4	16.2	15.5	87.8	8.0	8.1
12- 4	36.89	153.0	77.4	83.1	66.7	83.6	23.1	20.3	15.1	15.5	87.5	8.1	7.9
14-11	44.26	153.0	79.7	80.0	67.0	80.0	25.0	21.8	16.2	14.3	84.2	8.6	8.8
12- 8	40.97	153.0	80.3	81.1	68.3	79.7	21.7	22.0	15.7	16.0	85.8	8.5	8.8
14- 8	49.65	153.0	79.7	79.9	65.9	79.7	25.6	23.5	17.0	14.5	84.7	8.7	8.8
17- 0	50.10	152.7	82.8	78.7	62.6	78.7	26.0	23.5	16.7	15.2	84.7	8.8	9.0
13- 7	44.94	152.7	81.9	79.3	68.0	78.7	23.7	23.5	14.6	15.0	85.5	8.2	8.3
13- 7	44.86	152.7	78.1	83.3	68.9	82.9	24.0	23.6	18.0	15.5	87.9	7.7	8.1
13- 2	46.47	152.7	80.3	81.3	66.6	-	26.8	22.5	16.2	14.3	84.1	9.1	8.7
13- 7	44.94	152.7	82.2	81.5	67.5	80.2	26.0	25.0	17.2	14.2	85.1	8.7	8.8
16- 3	41.71	152.4	80.9	79.6	67.9	78.7	23.0	-	16.0	14.2	85.2	8.0	8.1
14- 6	49.36	152.4	81.3	-	-	-	25.3	25.0	16.8	14.0	85.8	9.0	9.0
13- 3	51.52	152.4	80.6	-	-	-	24.2	24.5	15.2	15.0	87.2	8.6	9.0
12- 0	36.93	152.4	80.0	79.9	66.9	81.0	24.0	21.0	15.0	14.5	86.2	8.3	8.5
15- 6	40.91	152.4	80.3	79.1	68.8	80.1	24.4	22.3	16.2	16.0	85.9	8.4	8.5
14- 0	40.52	152.4	80.9	77.7	74.0	78.1	24.0	21.8	15.3	12.5	84.3	8.3	8.2
12- 2	43.75	152.4	79.3	82.5	65.6	80.9	24.0	21.6	16.6	15.0	84.4	8.4	8.4
16- 4	46.15	152.1	82.8	76.2	65.9	-	25.5	22.2	15.7	15.8	84.6	8.6	8.5
13- 6	42.39	152.1	83.2	77.3	66.9	79.0	24.0	22.0	16.2	14.5	83.4	8.2	8.4
15- 2	43.18	151.8	81.3	-	-	-	25.7	21.2	15.6	15.8	83.7	8.3	8.4
15- 9	44.86	151.8	82.5	77.7	67.4	77.5	25.0	21.0	16.0	16.2	83.6	8.7	8.5
15- 0	41.31	151.4	76.5	82.5	68.0	82.3	22.0	22.0	16.8	14.5	85.6	8.0	8.4
14- 0	41.71	151.1	81.9	79.1	65.6	77.3	24.5	22.6	15.6	14.0	84.4	7.7	8.2
16- 4	45.00	150.8	76.2	83.4	66.9	82.0	26.0	24.3	17.6	15.0	84.8	9.0	9.1
13-10	40.80	150.8	75.2	81.6	68.6	82.6	23.0	22.0	17.0	14.0	84.2	7.5	8.0
15- 9	41.60	150.8	81.3	78.5	66.0	79.1	24.2	22.0	14.7	14.2	83.5	7.3	7.6
11- 7	35.13	150.5	77.4	-	-	-	24.0	20.6	14.6	14.0	85.6	8.6	8.3
12- 9	41.43	150.5	80.0	80.2	64.0	78.7	24.2	19.8	16.0	14.2	83.0	7.9	8.3
11- 0	43.41	150.5	81.3	80.2	63.9	77.7	24.3	23.3	17.0	14.2	84.2	8.2	8.7
13-11	37.97	150.5	82.8	76.2	64.7	76.3	23.4	21.3	14.5	14.0	83.0	8.1	8.1
12- 7	40.23	151.4	80.0	-	-	-	23.4	23.0	16.0	14.4	86.7	8.9	9.1
12- 7	35.58	151.4	78.7	79.4	64.6	81.0	22.5	21.0	15.0	13.5	83.0	8.2	7.4
13-11	38.19	150.5	77.8	81.5	66.8	82.0	21.8	21.3	16.0	13.8	85.9	7.5	7.8
12-10	47.38	150.2	78.1	79.6	65.8	-	25.7	23.0	16.6	16.0	83.8	9.0	8.9
12- 9	40.91	150.2	79.0	79.0	66.6	78.1	24.0	24.0	16.2	13.5	82.7	8.2	8.8
15- 0	44.88	150.2	80.6	77.3	64.6	75.9	22.6	21.3	17.7	15.7	81.1	8.4	8.0
11- 9	37.17	149.9	76.5	81.6	65.8	81.2	22.6	20.6	15.0	14.5	84.2	8.0	7.8
16-11	42.96	149.9	81.6	78.9	68.5	-	23.4	22.0	16.2	14.6	82.7	9.4	9.3
15- 8	40.12	149.9	79.7	79.3	68.0	78.9	23.4	23.0	15.7	14.4	83.5	8.1	8.0
12- 4	43.24	149.9	78.1	80.9	66.1	81.6	23.0	24.8	-	16.2	85.4	7.8	8.1
14-11	33.60	149.9	73.9	-	-	-	22.5	20.4	14.0	14.3	85.4	8.2	7.8
17- 8	37.97	149.9	82.8	-	-	-	24.0	22.0	14.5	12.3	85.9	8.2	8.6
15-11	53.51	149.9	-	77.3	68.6	-	25.5	24.1	16.8	15.0	82.5	9.2	9.3
14- 7	50.10	149.9	80.0	77.6	64.9	-	25.6	23.6	18.2	14.5	83.1	8.7	8.9
13- 7	38.14	149.5	77.8	79.7	65.0	79.2	23.0	20.6	15.8	14.8	84.4	7.7	7.8
14- 7	47.55	149.5	79.3	76.6	65.5	-	21.3	22.6	15.3	14.3	84.0	8.1	7.7
11- 9	35.58	149.5	74.9	82.5	67.7	82.2	22.2	21.0	15.2	13.4	85.5	7.7	7.9
12- 9	51.35	149.5	79.3	-	67.9	79.7	25.6	25.0	-	18.0	83.5	8.9	9.2
15- 0	51.86	149.5	83.2	-	-	-	27.0	26.0	16.0	14.8	83.6	10.0	10.5
12-10	37.29	149.3	79.0	-	-	-	21.6	20.3	13.5	15.0	82.7	8.0	7.7
12- 4	47.38	149.2	80.0	79.3	65.2	-	23.0	22.5	18.0	14.6	82.8	8.7	8.8
11-10	37.17	149.2	81.6	78.0	63.5	75.5	23.7	22.0	15.2	14.6	83.5	7.9	7.9

Table 10 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters: Transverse Pelvis	Diameters: Transverse Chest	Diameters: Anteroposterior Pelvis	Diameters: Anteroposterior Chest	Plane of gravity: From soles	Plane of gravity: From back at 25°	Plane of gravity: From back at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
13- 2	42.92	149.2	77.4	79.9	66.1	77.7	23.5	23.0	16.0	14.6	83.3	7.4	7.8
13- 3	46.47	149.2	76.5	82.0	68.3	81.7	24.8	22.0	17.0	15.1	85.9	9.1	8.9
16- 2	44.20	149.2	79.0	-	-	-	24.5	23.0	16.0	16.2	83.4	10.2	9.4
11- 3	41.20	148.9	78.1	76.5	66.3	75.6	25.2	22.8	16.2	14.0	82.9	8.3	8.4
15- 2	47.72	148.9	82.8	-	-	-	23.0	21.4	15.7	15.2	81.8	9.6	10.0
12- 5	31.73	148.9	78.1	77.1	64.7	77.9	23.4	18.5	13.3	13.4	83.4	7.0	7.0
12- 6	36.83	148.6	75.5	80.7	67.5	81.3	23.5	21.1	15.2	13.5	84.4	7.6	8.2
17- 1	43.30	148.6	79.3	-	-	-	26.1	20.7	15.4	14.5	81.2	8.6	8.3
12- 4	43.92	148.6	78.1	76.5	62.0	76.7	22.6	21.8	16.3	14.8	82.7	8.9	8.5
12- 5	36.72	148.3	77.1	79.7	67.2	77.9	23.5	21.7	15.5	14.8	83.8	8.4	8.1
13- 6	37.17	148.3	79.0	77.9	65.2	77.3	24.5	22.0	14.4	13.6	82.9	7.5	7.7
12- 6	41.20	148.0	79.3	76.0	66.5	76.6	23.0	22.0	15.8	16.6	82.8	8.1	8.2
11- 7	32.75	148.0	75.2	80.6	63.2	81.2	23.0	20.0	14.6	14.0	85.7	8.6	8.1
12- 1	36.37	148.0	77.1	78.0	65.5	79.1	22.0	19.6	13.5	15.0	82.4	7.3	7.3
12-11	42.67	148.0	79.3	78.8	64.8	78.6	24.2	21.2	15.6	14.3	82.9	8.9	8.7
10- 9	41.03	147.6	78.7	78.0	65.2	76.3	21.8	21.5	16.4	17.3	83.3	7.2	7.9
14- 6	39.78	147.3	79.0	79.3	66.6	-	23.0	21.5	15.5	14.5	82.4	8.0	8.0
13- 0	36.95	147.0	78.1	76.2	63.5	76.1	23.0	22.2	14.2	14.6	80.8	7.8	7.7
12- 5	36.48	147.0	73.9	80.1	67.8	79.2	22.6	22.0	15.4	14.6	84.9	8.9	8.8
11- 7	34.73	146.7	77.1	76.2	62.8	77.5	22.2	22.0	14.2	15.0	83.2	7.2	7.4
10- 8	31.50	146.7	76.2	78.3	64.3	78.5	22.7	20.5	14.6	13.0	79.4	10.0	11.3
12- 4	36.78	146.7	76.8	77.7	64.3	-	21.5	22.3	14.3	13.0	82.4	7.2	7.3
15- 5	43.64	146.7	80.6	74.1	63.0	-	23.3	22.5	14.8	14.4	81.9	8.0	7.9
11-11	39.89	146.4	74.9	78.9	66.5	78.5	24.0	21.0	16.1	15.0	83.4	7.6	7.8
13- 1	43.07	146.4	80.3	76.1	64.2	-	23.6	23.5	15.6	13.3	82.0	8.1	8.4
14- 1	44.49	146.4	79.7	76.4	62.0	-	24.5	23.2	16.0	14.6	82.0	8.5	8.4
13- 1	41.14	146.4	78.7	75.6	62.3	74.7	23.5	23.4	16.0	13.8	80.9	8.8	8.8
11- 8	31.79	146.4	74.3	77.5	60.9	74.2	20.4	20.3	14.0	13.8	82.9	7.7	7.5
13- 0	34.25	146.1	77.8	76.4	65.6	75.6	21.3	20.0	15.3	15.0	82.2	7.9	[illegible]
14- 0	40.23	146.1	80.0	74.2	66.6	74.6	23.0	23.8	15.7	16.0	81.6	7.4	7.9
9-11	43.18	146.1	77.4	77.7	62.8	71.7	23.6	20.8	16.4	14.3	81.3	9.0	8.6
11- 5	36.01	145.7	78.4	75.0	62.3	76.3	24.3	20.6	14.6	13.6	80.4	7.6	8.2
13- 2	34.56	145.4	74.6	79.2	61.4	79.4	23.0	20.3	15.2	15.1	79.6	7.3	7.1
13- 5	42.28	145.1	76.2	78.2	65.6	76.8	23.0	22.7	16.0	15.0	81.3	8.7	8.6
14- 1	38.82	145.1	77.1	76.5	63.9	75.0	25.2	23.5	15.3	15.0	81.2	7.6	8.4
11- 3	34.45	145.1	79.0	75.4	61.9	74.5	21.5	22.1	14.5	13.1	80.1	7.4	7.5
12- 5	36.32	145.1	80.0	77.5	62.7	76.3	22.1	22.0	14.0	13.6	81.1	7.8	8.3
13- 9	38.25	145.1	82.5	72.3	59.4	70.9	22.6	21.6	15.0	13.7	79.7	7.7	[illegible]
15- 4	34.45	144.8	77.4	74.0	64.9	72.9	24.0	21.7	14.3	13.8	81.8	7.2	7.9
11- 1	33.00	144.8	73.3	77.9	61.4	77.9	22.0	20.8	15.5	14.0	82.8	7.9	7.8
12- 2	42.73	144.8	74.6	79.7	62.5	-	22.6	23.0	15.4	15.6	81.3	8.7	8.2
11- 7	35.58	144.8	74.9	76.7	61.2	76.2	22.5	19.2	15.0	14.0	81.6	8.4	8.4
10- 8	36.15	144.5	75.2	78.0	61.2	78.0	21.2	21.2	15.3	15.0	81.9	8.4	8.4
10- 7	28.84	144.5	74.9	75.9	62.3	77.2	21.0	17.9	13.4	13.0	82.1	7.5	7.5
10-10	42.96	144.5	76.8	76.2	63.4	77.1	23.6	20.7	-	15.0	82.3	10.2	9.8
11- 5	35.13	144.5	75.9	77.5	65.0	76.7	22.5	20.1	16.0	14.3	81.5	8.3	8.5
11-10	32.92	144.1	74.6	76.4	63.4	76.0	20.5	20.2	15.0	14.2	80.6	7.3	7.1
12- 8	31.16	144.1	71.7	77.2	61.9	78.1	21.0	20.0	14.0	13.0	81.0	7.1	7.3
12- 9	41.82	144.1	76.5	74.2	63.5	75.3	21.5	23.5	16.0	13.6	80.3	8.6	8.7
12- 6	28.67	143.8	73.9	-	-	-	22.2	19.0	13.7	14.0	82.4	8.2	8.7
10- 1	36.49	143.8	75.2	78.5	62.4	78.8	23.4	22.0	15.6	15.4	82.1	7.9	7.9
13- 8	36.69	143.8	80.0	73.7	61.0	72.3	22.0	19.5	14.5	15.0	79.5	7.9	8.4
12- 5	46.70	143.5	74.5	76.9	61.9	-	24.3	23.5	17.5	16.5	80.8	8.4	8.3
10- 7	28.78	143.2	73.3	76.9	62.7	76.0	20.8	19.2	14.1	13.6	79.7	8.1	7.4
12-11	33.66	142.9	76.2	75.7	61.6	75.7	22.5	20.4	15.0	14.6	80.7	6.9	7.4
13- 9	31.28	142.9	72.7	77.0	64.9	76.6	21.4	20.6	14.2	13.0	81.6	8.0	8.5
13- 7	35.13	142.2	74.5	-	-	-	22.6	20.5	14.8	14.5	80.2	9.0	8.7
11- 5	44.37	142.2	76.2	71.9	62.4	71.9	23.8	24.0	-	18.0	80.2	8.8	8.7
11- 3	34.96	142.2	72.0	77.4	65.3	78.1	23.7	21.2	15.1	13.0	82.1	7.7	8.0
13- 2	36.04	141.9	74.6	-	-	-	22.8	21.7	14.3	13.6	79.4	7.9	8.4
12-11	36.15	141.9	73.9	74.6	61.3	74.7	21.0	22.0	15.0	13.3	79.1	7.4	7.5
12- 9	37.06	141.9	73.6	75.1	61.8	-	22.6	21.6	14.3	14.6	80.1	7.8	8.2
12- 8	34.32	141.6	75.2	73.5	62.2	72.7	21.0	22.0	14.6	14.0	80.6	8.1	7.9
11- 5	33.37	141.6	76.2	73.8	61.2	73.7	23.8	21.1	14.6	14.7	80.0	7.5	7.6
10- 7	32.07	141.6	74.9	70.1	60.2	69.5	22.0	19.5	14.1	14.0	78.1	7.7	8.0
11- 0	28.33	141.3	73.3	74.1	61.8	75.2	19.8	20.0	13.0	13.1	80.7	7.6	7.6
12- 1	37.91	141.3	76.5	75.6	62.9	74.6	22.0	22.4	15.4	14.4	78.4	8.2	8.3
11- 1	29.35	141.3	73.9	76.1	64.3	75.1	21.0	20.2	14.6	13.2	80.3	7.5	7.2
11- 2	30.65	141.3	73.6	74.1	61.6	73.3	22.7	20.4	13.2	12.6	79.8	7.3	7.5
10- 6	36.41	141.3	78.4	71.7	64.6	71.3	22.2	19.0	14.5	14.2	77.9	7.6	8.1
9- 7	37.51	141.0	75.5	74.0	62.2	72.9	21.7	21.0	15.0	15.0	80.0	7.7	8.1
11- 8	36.86	140.7	73.9	75.0	61.6	73.7	22.7	21.6	14.3	14.3	79.6	8.1	8.6
10-11	33.66	140.3	74.6	74.7	60.4	73.8	22.2	21.0	14.8	14.7	79.7	7.6	7.8
9- 6	35.07	140.3	70.5	72.4	59.0	-	20.2	20.3	15.0	14.2	78.7	7.9	8.2
10- 2	32.98	140.3	73.0	73.5	62.5	74.5	22.0	19.5	13.6	15.5	78.7	7.8	7.7
11- 9	31.73	140.3	78.1	70.8	60.6	72.0	20.4	20.8	13.8	12.8	77.8	8.5	8.0
11- 3	33.32	140.0	73.6	73.4	60.5	72.5	20.5	19.3	15.1	15.5	78.9	7.6	7.4
10- 4	31.84	140.0	72.4	72.7	60.2	74.6	21.0	21.5	14.0	14.6	80.5	7.8	7.9
10- 3	31.92	139.4	74.3	74.0	63.0	73.3	22.0	19.3	14.3	14.0	78.1	6.6	7.0
9- 9	29.87	139.1	71.1	75.0	61.6	73.9	23.0	20.4	13.7	13.5	79.1	7.3	7.8

Table 10 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters				Plane of gravity		
							Transverse		Anteroposterior				
							Pelvis	Chest	Pelvis	Chest	From soles	From back at 25°	at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
11- 3	31.28	139.1	72.7	72.3	62.0	74.1	21.2	20.6	14.0	12.5	78.2	8.3	8.6
9- 3	33.43	139.1	73.6	72.9	62.3	74.2	20.4	19.3	14.5	14.3	79.3	6.9	7.3
9- 9	30.34	138.7	71.7	-	60.2	75.0	21.0	18.5	12.6	14.2	77.8	7.6	7.9
12- 9	34.39	138.7	72.7	74.3	61.6	-	20.6	22.6	14.2	15.0	78.5	7.2	7.3
10- 8	32.58	138.7	70.5	76.7	62.8	76.1	21.7	19.7	14.2	14.0	78.8	7.0	6.9
11- 8	30.94	138.4	73.6	71.7	62.6	73.7	22.5	21.0	14.4	12.5	78.0	7.4	7.6
9-11	29.49	138.4	69.8	72.7	59.0	73.1	20.3	20.0	13.0	13.0	80.0	7.8	7.6
9- 8	43.41	138.1	74.6	74.6	60.3	-	23.6	21.5	16.6	15.5	77.2	8.7	9.0
12- 0	26.91	138.1	71.4	73.6	60.6	74.3	20.9	19.8	13.0	12.6	78.5	7.7	7.7
11- 7	29.01	138.1	75.2	69.6	60.0	63.9	19.5	19.6	13.3	14.4	77.4	7.5	7.6
10- 0	29.57	137.8	74.6	71.0	58.9	70.9	20.5	18.7	13.2	13.0	76.7	7.0	6.9
10- 4	29.01	137.8	73.0	72.9	58.4	73.8	21.0	20.5	13.7	14.0	78.4	7.8	7.4
10- 0	26.54	137.8	71.4	74.7	59.0	72.8	22.2	20.8	12.4	13.0	78.8	8.0	7.7
10- 9	38.48	137.5	75.9	73.1	61.9	-	22.4	21.6	16.1	15.5	77.2	7.9	8.3
10- 4	39.10	136.8	74.6	74.0	60.9	73.5	22.0	22.5	-	14.0	76.9	8.4	8.3
9- 2	29.85	136.5	73.0	67.8	57.0	70.0	20.0	19.5	12.2	13.0	77.5	7.0	7.2
9- 3	30.09	136.2	70.1	71.7	58.4	73.4	21.1	18.5	14.0	14.0	77.1	7.6	7.7
12- 0	29.43	135.9	70.1	71.1	58.7	72.0	21.1	21.0	14.6	13.5	76.5	7.2	7.1
11- 6	35.13	135.9	74.9	70.0	54.0	70.3	21.4	20.5	15.0	16.0	75.7	8.3	8.7
11- 7	32.01	135.9	72.7	71.0	59.4	70.7	22.0	20.3	13.3	13.9	75.7	7.4	7.6
8- 9	33.74	135.9	72.7	70.5	57.8	70.7	21.0	19.4	15.4	14.4	75.3	7.9	8.1
13- 0	30.37	135.7	71.7	71.1	57.7	71.3	20.3	20.7	14.3	13.6	76.9	7.4	7.7
9- 7	30.20	135.6	73.6	69.8	60.7	72.4	22.0	21.0	13.0	13.0	76.3	7.5	7.2
10- 2	27.10	135.6	70.5	72.6	58.1	71.6	21.6	18.9	13.5	13.1	77.3	7.0	7.2
9- 8	29.86	135.3	68.9	50.6	58.8	-	21.4	21.0	14.6	14.5	77.2	8.1	7.9
10- 8	32.01	135.3	71.1	70.2	57.5	69.5	21.7	19.0	14.1	13.7	75.6	7.6	7.5
9- 8	28.78	135.3	70.1	70.8	59.2	72.0	20.8	20.5	12.6	13.6	76.8	7.6	7.4
10- 2	36.83	135.3	74.3	69.1	60.0	-	21.5	21.5	14.0	14.2	75.9	8.4	9.0
12- 2	35.70	134.9	76.2	69.8	58.6	69.4	23.7	22.0	14.6	13.8	75.2	8.0	8.9
10- 0	28.55	134.9	72.4	70.0	57.5	70.0	20.6	18.0	13.6	14.0	75.1	6.7	7.0
8-10	38.27	134.9	73.9	69.8	58.1	-	22.1	20.8	-	14.0	74.4	8.7	9.0
9-11	29.69	134.6	71.7	68.3	59.7	-	19.6	21.3	13.3	14.0	77.0	7.2	7.4
11-10	27.42	134.6	73.6	68.5	56.2	69.2	20.0	19.1	13.0	14.0	75.2	7.6	8.0
9- 8	36.61	134.6	73.9	71.7	59.6	-	22.1	20.0	15.7	16.0	75.4	8.0	8.4
9- 9	32.95	134.0	70.5	69.9	58.5	70.0	21.6	20.8	15.5	15.0	75.4	7.6	8.1
8- 0	35.83	133.7	72.7	67.6	58.3	-	21.5	19.5	14.6	15.0	75.3	8.2	9.0
8- 3	26.42	133.7	69.8	68.6	57.4	69.4	20.6	18.5	13.2	14.0	76.4	8.1	7.3
8- 6	26.54	133.4	70.5	68.6	56.8	69.7	18.0	19.0	12.7	13.0	75.3	7.4	7.2
10- 1	25.89	133.0	71.1	69.0	58.0	68.9	18.7	19.5	13.5	14.0	76.5	8.3	7.9
10- 4	26.88	133.0	71.1	69.1	57.1	69.1	20.9	19.0	14.0	11.4	74.4	7.5	7.7
8- 5	29.94	132.7	72.4	66.6	57.9	67.6	20.0	20.3	13.0	15.4	74.2	7.3	7.5
9- 8	29.97	132.7	70.8	69.1	58.0	69.6	21.0	20.0	13.9	16.1	76.0	7.5	7.6
9- 4	27.82	132.7	72.4	69.1	58.4	68.8	21.0	19.8	12.3	13.4	75.8	7.7	7.4
8- 3	28.07	132.7	71.7	66.6	58.0	65.4	20.0	19.0	13.2	13.0	74.0	6.8	6.9
11- 0	37.74	132.7	70.8	69.6	56.3	-	21.8	21.0	14.6	15.2	75.6	8.2	8.3
8- 6	25.18	132.7	69.2	69.0	56.4	68.5	20.3	18.0	11.7	12.6	75.6	7.2	7.6
10- 1	26.06	132.7	67.9	70.1	58.5	70.7	20.8	19.8	13.0	12.5	74.8	7.3	6.9
10- 9	31.28	132.4	73.6	66.9	55.0	66.0	21.4	19.6	13.5	13.0	73.5	7.6	7.6
10- 6	33.77	132.4	69.8	71.0	56.6	-	21.8	21.2	13.7	14.8	75.6	7.8	8.3
10- 3	27.76	132.1	71.7	68.6	57.9	68.4	21.9	18.5	13.0	13.0	74.4	7.1	7.2
9- 8	29.12	132.1	68.6	69.6	58.1	-	20.5	19.0	13.8	14.0	75.4	7.6	7.5
10- 0	42.50	132.1	71.4	67.6	60.4	68.6	22.2	23.0	15.6	15.0	79.8	5.7	5.3
7-11	28.75	131.8	70.5	67.4	57.0	68.6	20.3	19.0	12.5	13.0	74.4	7.4	7.4
9- 2	25.49	131.8	70.5	68.2	54.9	69.2	19.5	19.8	11.9	12.3	74.3	7.5	7.7
9-11	27.50	131.8	71.1	68.6	57.4	67.6	12.5	19.6	13.0	12.6	74.5	7.7	7.2
11- 2	29.01	131.8	67.9	70.9	57.0	69.8	20.5	20.0	13.7	14.0	76.4	7.5	7.0
9-10	25.38	131.4	69.8	67.4	55.9	68.8	21.0	18.0	13.3	12.7	74.3	7.5	7.2
9- 5	26.74	131.4	71.1	66.8	58.3	67.8	20.0	19.5	12.2	15.6	75.7	8.3	7.9
10- 2	23.68	131.1	69.5	65.8	55.6	67.0	19.8	18.5	12.7	13.0	74.1	7.4	7.3
10- 9	24.53	131.1	68.6	68.2	57.5	68.2	21.2	19.0	13.8	12.5	75.1	7.6	7.2
9- 2	30.71	131.1	74.6	67.6	56.0	67.8	21.3	18.0	12.4	12.7	71.7	7.9	7.8
9-11	43.24	130.8	69.8	67.4	55.8	-	21.0	20.1	17.5	17.0	73.0	8.8	8.9
9- 2	28.67	130.8	68.6	66.4	53.9	-	21.2	18.6	13.5	12.2	72.7	6.8	7.1
10- 7	26.29	130.5	71.1	66.7	54.7	67.6	20.4	19.0	13.0	12.4	73.3	7.9	7.9
8-10	28.52	130.5	69.2	68.3	56.1	67.9	20.1	19.0	13.6	14.2	74.3	8.0	7.5
7-10	25.23	130.2	69.8	66.1	57.4	66.8	21.5	19.0	12.0	13.0	73.6	6.9	7.0
8- 2	29.03	129.5	70.5	67.0	56.3	68.4	19.6	19.2	14.0	12.6	73.4	8.3	7.8
8-10	28.52	129.5	68.9	66.4	57.0	67.0	20.5	18.6	13.0	13.8	74.0	7.4	7.4
8- 1	26.54	129.2	69.8	66.2	52.9	65.2	21.0	18.6	12.5	13.5	72.5	6.6	6.9
9-11	26.63	128.9	67.9	68.2	55.5	68.8	18.3	17.7	13.0	13.3	71.6	7.5	7.2
8- 9	28.49	128.9	70.8	66.8	53.0	68.1	19.8	20.4	13.2	12.5	72.4	7.5	7.3
9-11	25.55	128.6	67.6	68.0	55.5	67.3	19.3	17.6	12.3	13.4	72.7	6.8	7.0
7-10	31.87	128.6	71.1	-	54.5	68.6	20.5	19.7	13.0	14.2	72.4	8.1	8.1
7- 5	23.84	128.6	67.9	65.5	53.2	64.8	19.2	17.7	13.1	13.6	73.7	6.9	7.4
9-11	29.29	128.6	68.6	64.1	55.5	-	20.7	18.8	13.2	13.2	72.7	7.7	7.6
8-10	23.00	128.6	71.1	63.4	53.2	65.3	19.0	18.0	12.3	12.6	72.5	7.3	7.7
9- 2	23.70	128.3	65.7	69.0	53.6	69.2	19.7	19.0	12.6	12.5	75.2	9.1	8.5
8-11	24.36	128.3	65.4	65.9	54.9	66.8	19.0	18.3	12.0	12.4	73.5	8.1	8.1
8- 5	27.05	128.3	68.9	67.6	56.9	67.8	19.5	19.3	12.5	13.4	72.4	6.0	6.5
7- 9	26.99	128.3	67.3	67.8	53.2	-	20.0	19.5	13.4	14.2	72.7	7.0	7.1

Table 10 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters: Transverse Pelvis	Diameters: Transverse Chest	Diameters: Anteroposterior Pelvis	Diameters: Anteroposterior Chest	Plane of gravity: From soles	Plane of gravity: From back at 25°	Plane of gravity: From back at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
11- 0	23.48	128.3	67.6	68.1	57.0	67.9	18.6	18.6	12.2	12.5	73.1	7.1	7.2
10- 9	28.58	127.0	70.5	66.7	53.9	64.6	21.0	20.2	13.6	13.0	72.2	6.9	6.9
9-11	28.21	127.0	68.9	65.0	53.6	63.6	20.0	18.3	13.5	14.2	72.7	7.1	7.4
10-11	26.74	126.4	68.2	63.4	55.4	-	18.7	19.5	13.0	14.0	71.9	7.4	7.2
8- 7	23.36	126.0	66.0	54.9	54.6	55.8	19.4	19.0	12.0	11.8	71.3	7.4	7.4
8- 4	22.74	126.0	68.6	62.2	55.2	64.1	17.8	17.5	12.2	12.6	71.9	8.2	8.4
8- 3	24.75	125.7	67.9	63.8	53.7	64.7	20.0	19.2	12.7	14.0	72.1	7.2	7.1
6- 1	26.08	125.7	67.9	62.8	54.5	62.3	19.8	19.5	12.3	13.6	71.3	7.0	6.8
8- 2	22.85	125.7	66.0	66.2	55.4	65.4	20.3	17.3	12.6	12.7	71.0	7.1	7.2
9- 6	22.54	125.1	66.0	65.5	54.5	66.4	18.6	17.6	13.4	13.7	71.6	7.9	7.8
9- 3	25.95	125.1	67.9	63.5	53.3	63.3	20.3	20.0	14.4	13.0	70.6	7.1	7.3
10- 4	24.24	124.8	65.1	67.1	53.7	66.2	20.0	19.7	13.2	13.0	71.6	6.1	6.1
7-11	23.25	124.8	63.8	66.1	56.3	66.5	19.7	18.1	12.6	13.7	72.2	7.8	7.7
11- 3	26.06	124.5	66.0	63.8	55.8	65.2	20.8	19.0	12.5	12.4	70.4	6.2	6.6
7-11	19.73	123.8	65.7	63.4	50.8	63.6	18.5	16.5	12.2	11.0	69.8	6.8	6.5
6- 9	22.91	123.8	69.5	61.8	53.8	60.1	19.5	18.6	11.8	13.0	70.4	7.6	7.2
7- 4	21.23	123.2	67.6	61.8	51.2	61.4	19.8	17.3	12.0	11.0	70.1	7.7	7.4
7- 6	22.54	122.9	65.7	64.8	51.3	64.0	19.4	19.2	11.4	13.3	70.6	7.6	7.5
8- 1	21.66	122.6	64.1	63.4	52.4	62.8	18.8	17.8	11.8	12.5	70.6	7.6	7.1
7- 3	24.95	122.6	64.4	64.3	53.5	-	20.0	17.6	12.0	11.7	70.8	6.9	6.8
6- 8	22.62	122.6	67.3	62.6	48.8	-	18.5	18.0	12.5	13.3	69.4	7.6	7.4
6-10	24.38	122.6	65.1	62.9	52.5	-	18.0	18.7	12.3	13.0	69.9	6.9	7.3
6- 7	28.35	122.6	68.6	60.8	51.8	-	19.6	18.5	13.0	12.2	67.5	7.8	7.8
8- 4	22.74	122.6	66.3	60.6	51.3	61.0	18.0	18.5	11.6	12.2	69.6	7.9	7.9
8-10	22.11	122.2	66.6	60.9	57.5	62.6	19.1	18.6	12.0	11.5	69.7	8.0	7.6
8- 6	25.99	122.2	66.6	62.8	50.8	63.1	20.0	19.2	13.0	13.8	69.7	6.7	7.3
7- 5	22.57	122.2	66.6	60.4	54.7	61.6	18.6	18.0	11.6	13.0	69.0	7.5	7.4
6- 9	23.70	122.2	68.6	60.4	51.5	60.6	17.8	18.0	11.8	13.0	68.9	8.0	8.1
6- 9	22.34	121.9	66.0	61.5	53.8	62.8	19.8	18.5	11.4	12.5	70.1	7.6	8.0
8-11	24.61	121.9	67.9	60.4	51.2	60.0	18.5	18.5	12.0	12.5	68.5	6.8	7.0
8- 4	24.49	121.9	67.0	-	-	-	20.5	20.0	12.6	12.9	69.8	7.7	8.4
7- 0	23.59	121.6	66.0	62.6	55.8	62.0	19.3	19.0	12.0	12.2	69.3	7.2	7.1
7- 0	21.04	121.3	65.4	59.8	49.7	60.8	18.3	18.2	11.6	12.8	69.7	6.0	7.0
8- 2	23.36	121.3	65.4	61.4	51.9	62.4	18.0	18.0	11.3	13.0	69.4	6.5	7.3
7- 2	22.23	121.3	66.6	61.7	51.7	60.3	18.7	18.8	13.0	13.1	69.6	7.3	8.0
7- 0	18.77	120.7	64.4	60.5	51.9	61.9	17.8	16.5	11.2	11.0	69.2	6.0	6.7
7- 9	22.91	120.7	63.5	62.8	52.7	62.9	13.5	18.3	12.0	12.7	69.3	7.6	7.3
8- 6	25.06	120.7	66.6	59.8	51.7	-	18.0	18.6	13.0	13.6	68.7	7.3	7.1
8- 8	22.11	120.5	66.6	59.9	52.4	61.0	18.8	18.3	12.0	11.5	69.8	7.3	7.2
6- 5	21.89	120.3	67.0	59.1	52.1	59.0	19.8	19.9	12.3	10.8	67.8	7.0	6.7
8- 7	24.10	120.3	64.7	61.0	52.8	61.8	19.7	18.5	13.2	13.4	68.7	7.4	7.5
6-10	22.34	119.7	62.8	61.6	51.4	61.4	18.7	18.9	12.0	12.8	68.8	8.0	-
8-10	21.05	119.3	66.5	62.0	-	62.4	-	-	-	12.5	68.9	7.1	6.1
6- 5	22.79	119.1	64.7	58.9	50.8	58.9	18.0	17.3	12.0	13.4	67.3	7.9	7.6
7- 9	19.51	118.4	62.8	60.2	51.7	60.2	16.3	16.0	11.0	11.0	67.4	6.2	6.6
6- 8	20.98	118.1	64.1	59.9	50.4	60.1	17.0	18.0	11.0	12.5	68.0	7.9	7.6
8- 3	22.06	117.8	64.4	60.6	57.3	59.8	17.2	18.8	11.0	11.7	67.3	7.7	7.0
8- 1	21.81	117.6	65.7	69.2	-	60.9	-	-	-	10.5	69.0	7.3	-
6- 5	20.30	117.5	63.5	59.6	49.8	60.6	18.6	17.5	11.5	12.0	68.2	7.8	7.8
5- 9	21.55	117.2	64.1	-	-	-	18.2	18.0	11.5	13.0	66.5	6.2	6.7
7- 5	20.75	116.2	65.4	56.5	49.3	-	17.5	16.1	11.1	12.6	65.7	7.4	7.3
6- 0	21.26	116.2	65.1	58.2	52.6	57.7	18.5	17.8	11.5	12.0	66.6	7.6	7.4
6- 1	22.97	115.5	67.5	58.4	-	59.7	-	-	-	13.5	66.2	7.3	-
6- 1	21.72	115.4	-	-	-	-	-	-	-	-	66.8	7.5	-
6- 0	19.51	115.3	64.1	56.6	50.1	57.1	18.6	17.5	10.1	12.5	66.2	7.3	7.4
7- 3	20.75	115.3	61.9	58.6	50.6	59.2	18.6	17.7	11.0	13.8	66.9	7.6	7.2
5-11	20.24	115.3	62.2	57.8	49.3	-	16.2	17.7	11.2	11.0	65.7	6.1	6.4
6- 7	20.98	115.3	63.2	55.9	48.6	-	18.0	17.0	11.5	12.0	64.2	7.2	6.9
5- 3	19.95	115.2	-	-	-	-	-	-	-	-	66.7	7.2	7.1
7- 5	19.17	114.9	62.8	56.4	48.3	57.8	17.7	17.2	10.5	12.2	64.9	6.5	7.3
6-11	22.62	114.9	63.5	56.6	50.6	57.9	17.9	18.4	12.3	13.5	65.2	7.1	6.9
7-11	18.77	114.6	61.2	58.2	46.7	58.6	16.2	16.8	10.2	13.3	66.3	6.1	6.2
5- 3	19.99	114.5	61.5	56.7	47.8	57.2	-	18.2	11.8	14.0	66.2	7.6	7.3
6- 5	19.85	114.4	-	-	-	-	-	-	-	-	65.3	7.0	6.8
5- 9	21.66	114.3	65.4	54.6	47.5	56.7	18.3	18.5	12.0	13.3	65.1	6.3	7.2
4- 4	19.45	114.0	65.1	55.6	48.0	55.9	17.5	18.6	11.4	12.0	65.4	7.2	7.3
5- 3	19.94	113.8	63.0	55.4	47.9	57.0	18.0	17.6	12.0	14.4	65.3	8.3	7.6
5- 7	21.09	113.5	62.8	56.0	49.0	56.5	17.3	18.2	12.0	13.0	65.5	7.8	8.1
5- 1	19.85	101.6	60.9	53.7	45.7	54.6	17.0	18.0	12.1	12.1	65.3	7.6	7.6
4-11	19.85	111.3	60.5	55.9	49.1	56.9	-	17.6	11.9	14.0	65.2	8.0	7.2
5- 2	19.55	111.0	-	-	-	-	-	-	-	-	64.2	7.5	7.2
7- 1	16.90	110.8	62.8	53.8	46.0	53.9	17.2	17.1	10.7	11.5	64.5	7.2	7.0
5- 0	18.90	110.8	63.0	52.8	46.4	54.0	17.6	17.5	12.0	14.2	64.8	7.4	6.5
4- 6	20.32	110.4	-	-	-	-	-	-	-	-	64.6	7.6	-
4- 7	19.50	110.1	60.1	55.2	49.0	57.2	17.7	17.7	11.4	13.4	65.4	7.8	7.3
7- 5	19.85	109.9	60.0	55.3	46.5	55.9	17.0	17.2	11.5	13.2	63.2	7.3	7.0
4- 8	17.12	109.9	62.2	-	-	-	16.1	17.0	10.0	12.5	64.1	6.3	6.9
5-11	19.96	109.9	61.2	55.1	49.1	-	17.5	18.0	11.8	13.6	62.7	7.3	6.9
4- 9	18.67	109.5	60.1	55.5	44.6	54.4	17.8	18.1	10.4	12.7	64.1	6.8	6.6
5- 5	17.75	109.4	-	-	-	-	-	-	-	-	63.9	7.3	6.5

CHILD DEVELOPMENT

Table 10 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters				Plane of gravity		
							Transverse		Anteroposterior		From soles	From back	
							Pelvis	Chest	Pelvis	Chest		at 25°	at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
5- 3	18.56	109.3	62.3	52.6	46.8	53.5	18.3	19.5	11.5	13.8	62.7	6.4	6.5
7- 2	18.31	109.2	61.6	53.8	45.8	-	17.3	17.2	10.4	12.2	62.4	7.4	7.4
6- 3	19.17	109.2	62.2	53.2	48.9	-	18.1	16.9	11.0	13.3	63.0	6.7	7.0
5- 2	18.37	109.2	60.3	52.9	46.9	51.9	16.8	17.0	11.4	12.0	62.1	6.6	7.0
5- 7	20.64	109.2	61.6	52.8	47.0	-	17.7	18.0	11.8	12.8	62.2	7.6	7.3
5- 2	19.32	109.0	-	-	-	-	-	-	-	-	61.8	7.3	6.4
5- 3	18.20	108.9	61.6	51.5	44.1	52.3	16.1	16.1	11.3	10.9	60.9	5.0	6.2
4- 9	19.91	108.8	-	-	-	-	-	-	-	-	63.8	6.3	5.3
6- 2	18.90	108.7	-	-	-	-	-	-	-	-	62.6	8.2	7.4
5- 8	23.15	108.5	66.4	51.2	-	49.0	-	-	-	16.0	61.3	8.0	-
5- 8	19.28	108.0	60.0	53.3	47.9	53.6	17.6	17.4	10.4	12.0	63.6	6.7	7.0
5- 9	17.35	108.0	60.3	55.9	46.9	-	16.0	16.0	11.1	12.3	61.3	7.0	6.1
4- 6	17.52	108.0	59.6	52.7	43.4	53.2	17.7	18.2	10.4	12.6	63.0	6.8	6.8
5- 5	16.76	107.6	-	-	-	-	-	-	-	-	61.3	6.5	-
5- 7	18.03	107.3	58.4	51.8	48.6	53.0	17.9	16.4	10.4	13.2	62.3	6.9	5.8
4- 1	18.45	107.3	62.7	51.2	41.6	51.3	17.8	17.1	11.2	14.3	61.4	6.9	7.0
4-11	17.82	107.2	60.5	50.9	47.8	54.6	17.9	18.9	11.4	13.4	61.9	7.1	6.8
5- 3	17.04	107.1	-	-	-	-	-	-	-	-	61.6	7.2	6.5
4-11	17.86	106.7	59.7	50.9	44.8	52.1	16.2	16.9	10.4	11.5	60.2	7.2	6.4
4- 4	17.46	106.7	58.1	53.2	45.3	53.3	16.3	15.9	10.3	11.1	61.7	7.1	6.8
4- 9	18.25	106.6	60.0	53.0	45.2	53.6	17.0	18.4	11.8	13.0	61.3	6.6	6.6
5- 1	17.46	105.7	57.4	52.9	44.7	-	16.0	16.5	10.9	12.1	61.7	5.9	5.8
4- 5	16.70	105.7	59.4	50.0	45.2	53.1	17.1	17.2	12.0	14.2	60.8	6.3	-
4- 1	16.52	105.6	60.0	50.7	44.6	52.2	17.2	17.6	11.0	13.4	61.8	7.8	7.3
5- 2	18.01	105.0	-	-	-	-	-	-	-	-	61.7	7.3	7.1
4- 8	19.50	105.0	57.9	50.2	41.1	51.6	18.1	19.3	11.5	13.4	59.1	7.3	-
4- 1	16.90	104.8	59.0	51.0	44.5	50.0	16.0	16.8	10.0	12.1	61.4	6.3	7.2
3-11	16.42	104.8	61.1	48.9	45.4	49.2	16.0	16.5	11.8	13.8	59.7	6.8	-
4- 3	18.60	104.8	60.3	49.2	44.9	-	17.0	17.5	10.4	12.1	60.3	5.9	5.7
3-11	17.95	104.6	56.9	51.1	44.5	53.5	-	17.6	12.2	14.0	60.2	6.9	5.9
5- 5	17.52	104.5	58.4	51.1	44.4	-	17.0	17.2	10.6	12.2	61.0	7.8	7.3
4-10	16.40	104.5	59.1	48.8	43.3	50.5	16.6	17.3	11.2	12.4	60.3	6.7	-
3- 9	16.90	103.4	59.8	48.8	44.4	51.9	17.3	16.4	10.8	13.8	60.0	8.8	6.9
4- 8	19.39	103.2	58.4	49.0	43.7	-	17.0	17.5	11.2	13.0	59.1	6.7	7.0
4- 4	16.22	102.9	55.2	49.5	43.3	-	16.5	17.0	9.9	12.0	59.9	5.5	6.6
3-10	17.95	102.5	57.5	50.2	43.4	51.6	16.9	18.7	11.1	13.4	58.3	11.1	10.0
4- 7	17.41	102.2	59.0	48.5	44.8	-	17.0	17.1	10.5	12.2	58.6	6.9	6.8
4- 1	17.80	101.9	59.7	48.2	41.9	-	16.0	16.0	10.1	12.0	58.5	6.8	6.8
3- 6	16.15	101.4	57.2	50.1	42.4	51.2	16.9	18.1	11.0	12.7	58.5	6.8	6.5
3- 8	15.05	101.4	57.6	50.7	43.0	51.7	16.1	17.7	9.8	12.6	57.5	6.6	-
3- 0	17.21	101.1	61.5	45.5	37.4	46.7	16.2	17.2	10.6	14.0	57.2	7.5	7.2
3- 5	14.52	101.0	56.6	49.0	42.8	50.0	15.8	17.5	9.7	12.6	58.3	7.1	-
3- 8	16.47	100.9	58.8	47.4	43.6	48.0	15.8	16.7	1[illegible].0	14.2	57.9	7.4	7.0
4- 6	16.54	100.8	58.9	46.6	41.9	46.5	15.5	16.9	11.9	14.0	57.6	7.2	-
4- 7	15.88	100.3	58.7	47.3	42.6	-	16.0	17.3	10.5	12.1	57.4	6.0	6.0
4- 5	14.60	100.3	57.9	48.8	39.8	48.7	17.0	16.6	9.8	12.5	58.6	6.3	6.2
3-11	16.17	100.2	58.3	46.2	43.8	48.2	17.3	18.5	11.0	12.9	58.1	6.8	6.6
4- 0	16.36	99.5	58.0	46.5	39.8	47.3	16.4	16.8	10.1	12.9	57.9	7.8	6.9
3- 9	14.86	99.1	53.3	48.8	43.1	-	16.0	16.0	10.0	11.5	57.6	5.8	5.8
3- 6	16.22	99.1	58.6	47.6	38.7	49.3	16.1	16.9	9.6	12.7	57.8	8.0	6.8
4- 3	15.65	98.7	57.4	50.0	39.9	46.5	15.6	17.3	9.7	10.5	57.1	6.4	6.9
4- 1	16.07	98.4	56.5	41.1	42.7	-	15.8	17.0	11.1	12.0	56.4	6.4	6.3
3- 7	14.63	98.1	56.5	47.5	40.7	-	15.0	16.8	10.0	11.2	57.0	6.9	6.6
3-10	16.10	97.8	55.2	45.7	42.6	45.7	16.0	16.3	10.4	11.3	55.3	6.6	7.3
3- 7	14.97	97.8	55.9	46.4	40.4	45.7	15.2	16.8	10.4	10.7	56.1	6.4	6.1
3-10	13.78	97.8	54.9	46.3	41.2	47.4	16.1	16.2	9.6	11.1	56.1	6.7	5.7
3- 8	15.88	97.8	55.9	46.7	41.5	-	17.0	16.1	10.1	12.1	56.4	6.3	6.6
3- 9	14.62	97.6	57.2	46.0	36.4	48.5	16.9	17.0	9.9	12.3	55.9	6.8	6.8
4- 1	15.20	97.4	56.8	45.1	41.2	-	15.7	15.7	10.0	11.5	55.4	6.6	5.9
4- 4	17.01	96.8	61.4	44.8	-	44.5	-	-	-	14.6	56.4	7.1	-
2-10	14.92	96.2	55.4	46.0	39.6	46.1	16.2	16.9	10.0	12.4	55.3	6.8	6.6
3- 3	16.67	95.6	53.6	45.8	40.3	-	16.3	16.4	11.0	13.4	54.2	6.2	6.1
2- 9	14.07	94.7	55.2	43.8	40.3	46.6	15.6	17.1	10.5	12.7	55.9	7.1	7.0
3- 1	15.63	94.4	-	-	-	-	-	-	-	-	53.8	7.0	6.7
2-10	15.60	94.3	-	-	-	-	-	-	-	-	54.3	7.8	-
3-10	13.78	94.3	54.3	44.8	39.9	44.9	14.7	16.2	9.6	12.0	55.0	7.0	7.1
2-10	13.62	94.0	-	-	-	-	-	-	-	-	55.6	7.3	6.9
2- 9	14.55	94.0	55.6	43.9	38.1	45.9	16.2	16.3	10.4	12.8	54.6	6.9	6.6
3- 0	14.00	93.7	53.7	44.3	36.4	44.7	14.7	16.2	10.1	11.9	54.7	7.2	7.2
2- 6	13.52	93.7	55.2	44.4	39.1	45.8	16.0	16.7	9.4	12.3	54.7	7.3	6.8
2-10	12.87	93.0	55.2	42.0	43.2	39.0	14.0	16.6	9.5	11.5	53.4	5.8	5.9
3-11	16.78	93.0	54.9	43.5	39.9	41.0	15.7	16.7	10.2	12.5	53.1	6.7	7.2
3- 2	14.63	92.7	55.9	42.7	39.3	-	15.6	15.6	10.2	11.8	54.5	6.5	6.2
2- 6	14.50	92.5	55.2	42.7	37.0	43.3	16.0	16.5	9.7	11.9	53.9	7.6	-
2- 4	13.16	91.4	54.0	40.9	37.7	42.7	15.6	16.3	10.3	12.9	52.8	6.5	-
2- 9	13.72	90.8	53.9	42.1	39.9	-	14.6	16.0	9.4	11.8	52.8	6.5	-
3-10	12.10	90.3	54.2	42.0	-	42.4	-	-	-	12.0	52.9	6.5	6.1
2-10	13.84	90.2	53.9	40.4	44.0	33.5	15.5	16.0	9.9	11.5	50.9	4.4	5.5
2- 3	12.65	89.8	52.8	42.1	36.6	43.1	14.8	15.8	9.1	11.5	52.1	6.4	6.2
2- 4	13.15	89.7	55.5	41.5	-	41.7	-	-	-	13.5	51.4	6.7	6.4

Table 10 (Continued)

Age	Weight	Stature	Sitting height	Pubic height	Arm length	Leg length	Diameters: Transverse Pelvis	Diameters: Transverse Chest	Diameters: Anteroposterior Pelvis	Diameters: Anteroposterior Chest	Plane of gravity: From soles	Plane of gravity: From back at 25°	Plane of gravity: From back at 30°
(yr-mo)	(kg)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
2- 8	12.80	89.6	53.4	41.2	36.6	41.9	15.8	16.5	9.1	10.9	51.7	7.2	6.9
2- 9	13.61	89.2	51.4	41.7	40.8	41.9	15.9	16.0	9.9	11.8	52.3	7.8	6.9
2- 4	12.53	88.9	52.4	42.1	38.2	-	14.6	15.8	9.9	12.0	50.9	6.4	6.9
2- 9	12.25	88.9	52.7	39.9	38.1	41.1	15.0	15.2	9.7	11.2	51.4	7.1	6.2
1-11	13.65	88.0	-	-	-	-	-	-	-	-	51.8	-	-
2-11	12.30	87.2	52.2	39.6	33.6	42.1	14.1	15.9	9.2	12.6	50.4	6.5	-
2- 5	12.55	87.0	53.0	42.7	-	-	-	-	-	14.0	52.5	7.4	-
2- 7	13.84	86.1	51.1	40.0	40.0	-	15.5	15.0	10.0	11.6	48.8	6.4	7.6
1- 9	12.25	85.7	49.1	38.1	35.8	-	-	-	-	-	47.9	5.8	6.2
1- 7	12.70	81.6	50.4	35.3	23.9	-	13.0	15.0	9.0	11.5	44.1	8.3	6.8
2- 4	11.23	77.7	48.2	34.5	30.8	-	-	-	-	-	44.8	8.3	8.5
0-10	9.63	-	47.0	-	31.3	34.7	13.4	15.8	9.3	11.2	40.9	9.5	-
0-10	9.74	-	45.0	-	32.5	34.5	12.8	14.4	8.1	10.5	41.6	8.0	-
0-10	8.70	-	44.6	-	30.0	31.0	11.9	14.2	8.4	11.0	39.5	8.6	-
0- 6	7.65	-	-	28.7	-	29.5	-	-	-	-	39.4	8.1	-
0- 6	7.75	-	45.9	29.6	-	29.0	-	-	-	10.9	41.2	9.3	-
0- 9	7.52	-	41.9	-	28.5	31.1	11.8	14.4	7.8	9.0	37.9	5.1	6.4
0- 7	7.60	-	-	28.6	30.1	-	-	-	-	-	37.0	8.8	11.1
0- 8	5.20	-	43.7	26.0	-	24.0	-	-	-	9.8	38.0	9.2	-
0- 4	5.35	-	42.4	22.9	-	24.0	-	-	-	10.6	39.2	9.0	-
0- 1	5.16	-	40.8	23.2	-	23.5	-	-	-	10.7	35.3	10.1	-
0- 2	4.50	-	38.4	22.0	-	21.0	-	-	-	10.9	31.9	6.1	-
0- 1	5.08	-	38.0	21.0	-	22.0	-	-	-	10.1	36.0	6.1	-
0- 2	3.71	-	36.6	21.6	-	22.7	-	-	-	9.5	32.6	9.0	-
0- 1	3.94	-	35.6	21.1	-	20.7	-	-	-	10.2	31.3	8.4	-
0- 1	3.12	-	34.2	20.1	-	20.0	-	-	-	10.2	28.8	6.7	-

Table 11

Observations upon the transverse and frontal planes of gravity, sex, weight, crown-heel and crown-rump lengths, pubic height, and leg length for fetal cadavera

Sex	Weight	Crown-heel length	Crown-rump length	Pubic height	Leg length	Plane of gravity	
						From soles	From back at 25°
	(kg.)	(cm.)	(cm.)	(cm.)	(cm.)	(cm.)	(cm.)
M	0.430	28.4	19.0	9.9	12.8	14.7	3.3
M	0.490	28.5	19.0	11.2	13.4	18.3	2.9
F	1.010	35.1	-	14.0	-	21.0	3.7
F	1.030	35.7	-	14.4	-	21.3	3.7
F	1.080	37.7	25.8	14.9	15.0	22.4	2.3
F	1.050	38.3	25.6	14.5	16.4	23.4	2.3
M	1.110	39.0	25.8	15.0	16.5	23.3	3.1
M	1.660	40.0	-	15.4	-	23.8	5.6
M	1.505	40.7	-	14.0	-	23.7	2.3
M	2.190	45.1	-	16.8	-	26.4	3.7
F	2.510	48.0	34.3	17.4	18.4	28.7	4.2
M	2.260	48.3	32.7	18.1	17.2	26.8	3.9
F	3.260	50.0	-	19.0	-	28.8	6.2
M	2.885	50.5	-	19.5	-	30.3	4.5
F	3.360	51.0	-	19.5	-	30.3	5.3
F	3.630	52.0	35.8	19.5	21.4	30.1	4.4
F	3.390	53.5	39.2	19.7	19.5	29.7	4.3
F	4.300	55.0	-	20.8	-	31.3	4.1

Contents for June and September

Information for Contributors and Subscribers

Child Development, one of three publications issued by the Society for Research in Child Development, is devoted to brief papers of current research in the child field. The journal is issued quarterly in March, June, September and December. The subscription price is $4.00 per year, postpaid. A limited supply of back issues is available at $1.25 per number. Until the supply is exhausted, complete sets, Volumes 1 to 14 inclusive, may be obtained for $28.00.

Other publications of the Society include *Child Development Abstracts and Bibliography* and *Monographs of the Society for Research in Child Development.*

Child Development Abstracts and Bibliography, now in its eighteenth yearly volume, is issued February through December—six numbers to a volume. The subscription price is $5.00 per year, postpaid.

Monographs of the Society for Research in Child Development, issued irregularly during the year, consist primarily of detailed critical reviews and seriatim studies. The subscription price is $4.00 per yearly volume.

The three publications of the Society are available at the special price of $10.00 per year.

Correspondence relating to articles and papers for publication in *Child Development* should be sent to Dr. Carroll E. Palmer, Society for Research in Child Development, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Correspondence relating to studies for publication in the Monograph Series should be sent to Dr. L. W. Sontag, The Samuel S. Fels Research Institute, Antioch College, Yellow Springs, Ohio.

Correspondence relating to subscriptions and business matters for all publications should be sent to the Editorial Office, Society for Research in Child Development, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.